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RURAL STREET-LIGHTING CONTRACTS.

The extension of central-station lighting service into country highways marks the yielding of the last stronghold of conservatism to the benefits of improved street illumination. As yet, however, only a very small percentage of the territory between large centers of population is provided with adequate street lighting, and on thousands of miles of roads within economic radius of central-station service, the moon and the farmer's lantern, supplemented by the occasional automobile searchlight, are all that stand between the wayfarer and total darkness. Along the routes of interurban trolley lines much good has frequently been accomplished by the installation of incandescent lamps upon the overhead structures, but as yet too little attention has been paid to the value of all-night lighting by small but frequent units, particularly on side streets.

Both engineering and commercial questions must be faced before this class of service can be widely extended, but with present equipment the problem is chiefly commercial. The life of the series tungsten lamp is now admirably suited to service on remote highways; the current requirements are nominal; distribution can be controlled from a central point with the most trifling labor cost; and so far as the question of maintenance enters, the motor-cycle makes replacements of broken or burned-out bulbs a simple matter. Multiple circuits are being used to some extent in compact villages, but in the main, the series circuit, supplied from the constant-current transformer at a point accessible to the attendant charged with the starting and stopping of the service, best meets the conditions in serving wide areas.

The real difficulties are of another kind. They are based for the most part upon the conservative attitude of influential but rather parsimonious citizens who look upon each light added to the system as a heavy tax upon the community, and who fail to see the benefit to the town from a well illuminated group of thoroughfares. The following statement from a former selectman illustrates an attitude which many managers will appreciate:

"I can hardly believe yet that the selectmen intend to have those twenty-six extra lights put in without calling a meeting of the voters to get their approval. It's just like their going to work and saddling the town with a debt of $10,400. We will have to pay $16 per light, and that $16 is

four per cent of $400, and so the twenty-six new ones make $10,400. What is the good of getting a reduction in the price per lamp if you are going to work and add enough lamps to take away all the gain? The company knows well that if these lights come, they come to stay, and so they add all they can. There never have been any lights removed yet from the town, but if the number was changed, it was always by the addition of new lamps. The next thing we know the town will be having five-lamp clusters put in on the main thoroughfares!''

There are elements of humor in this point of view, and the progressive manager does not have to look far to find between the lines an unconscious tribute to the quickness with which the community appreciates the permanent value of electricity on the rural thoroughfares. The fact is that what is needed most of all in securing lighting contracts in rural communities is ability to deal with the human side of the problem. The whole tendency of the times is toward better street illumination; real-estate values rise and outside residents are attracted by it; and apart from the reduction of accidents and the improved conditions of public safety afforded, the rural community finds itself acquiring a reputation as a live center if it devotes a reasonable sum yearly to meeting the lighting problem with courage and far-sightedness. In this field one group of lamps leads to another; the trial installation is a powerful object lesson; and the cost per capita per year is small, even for all-night service.

SYNTHETIC RUBBER.

With the exception, perhaps, of the automobile trade, electrical manufacturing interests are responsible each year for the consumption of more rubber than any other industry. Up to the present time nothing has been found which resists so well the effects of dampness and exposure and at the same time has and retains good wire-insulating properties as does this product of the tropical countries. Into the United States alone there were imported 91,000,000 pounds of crude rubber during the first six months of the current year, and it is safe to say that a good proportion of this went to electrical supply manufacturers.

As yet there has been only the supply from the rubber trees of the tropics, reinforced by the recently developed guayule rubber of Mexico, but indications now point, according to the *India Rubber World*, to the development of a process whereby synthetic rubber may be produced in sufficient quantities and at a low enough price to add considerably to the present production. Quite extensive experiments have been carried out, and one European firm is said to be producing the synthetic material at the rate of 200 pounds per day. At present this cannot compete in price with the crude rubber or the so-called reclaimed rubber, and perfection in the process of manufacture has not been attained, but there seems to be good authority for the statement that artificial rubber, produced mainly from coal tar, is being placed on the market. Also a company was recently established in Paris, France, for the manufacture of rubber from turpentine and other materials.

Apparently no investigations of the insulating properties or the stretching qualities of this synthetic product have been published, and the whole question is yet in the experimental stage. The production of synthetic rubber is interesting, however, as there is in connection with its success a prospect of a change in the price of electrical goods using rubber insulation. Anything in the way of a lowering in price of raw materials will be welcomed by the manufacturers and by the trade.

THE IMPORTANCE OF THE POWER-FACTOR.

The increasing tendency of central stations to confine their sales in the main to the alternating-current field creates a need for a better appreciation of the importance of the power-factor, particularly from the commercial point of view. The problem of the power-factor came into prominence in the earliest days of alternating-current distribution. Electrical engineers know well enough that the treatment of this question is one of the most serious in central-station practice, particularly in relation to the determination of the expediency of inaugurating a relatively high charge for service to consumers handicapped by poor power-factors and the economic desirability of installing synchronous apparatus as compared with the policy of providing extra capacity in the system of distribution to offset the crowding of transformer, meter and conductor circuits with current considerably out of phase with the impressed voltage. Some of the most profound studies of central-station distribution in recent years have been focused upon the control of power-factor, and the growing popularity of rotary condensers in certain cases testifies that the problem is one of no little import.

At present the detailed analysis of distribution systems with reference to improving the power-factor is a task for the specialist, and it may safely be left in his hands, provided that there comes about a wider appreciation of what the power-factor means commercially. Dr. Louis Bell has put the case in a nutshell by pointing out that the result of sending amperes into an inductive load amounts to slowing down the current, so that instead of having the maximum amperes come at the same time as the maximum volts, they come at a period of time, perhaps 0.002 second after the maximum volts, and then when we multiply the average volts by the average amperes we do not get the same result as when we multiply the volts at one moment of time by the amperes at the same moment and then average the momentary results to get the true watts. Instead, the average volts times the average amperes gives a considerably higher result than the true average watts. The reason why power-factor affects the central station is that while the latter sells watts or kilowatts, what it actually

delivers is amperes at some given voltage; and the product of the amperes, volts and power-factor gives to the consumer so many watts with which to do his work.

Employees in the sales departments of central stations do not always appreciate these points, and particularly the fact that all transformers, meters, cables, regulators, generators, etc., must be designed by the amperes which they are to carry, without immediate regard to the kilowatts which can be sold at the consumer's installation. This means that when the plant has such a load as an alternating-current motor to carry, it may have to supply an investment for say 100 amperes, and if the power-factor were 100 per cent, this would enable the company to sell 100 amperes times 110 volts, or 11 kilowatts; but on account of the fact that the inductive load slows down the current, so to speak, it can sell only a less amount of true watts, as 7.7 kilowatts in case of a seventy-per-cent power-factor. This means that extra capacity must be provided in generating and distributing equipment and also involves carrying unnecessary current over the lines, with consequent loss in heating apparatus which would be unnecessary if only the minimum current to do the work were supplied. Further, the effect is to make the regulation bad, because the pressure at the station end of the feeders must be high enough to force all the amperes through the lines as well as the current essential to do the work. Still more, these unnecessary amperes react on the generator and make it more difficult to keep the pressure constant.

On the commercial side, this means that if a customer has a power-factor of say, 66.7 per cent only, he pays the central station for 66.7 kilowatts, but uses 100 kilovolt-amperes, from which the company could sell 33.3 additional kilowatts if the power-factor were 100 per cent. The transformer investment in such a case is one and one-half times what it would be with 100-per-cent power-factor, and the meter likewise must be correspondingly large. To prevent overheating, the line must have one and one-half times as much copper as when the current and impressed voltage are in phase. The energy wasted in transmitting is proportional to the square of the current, and it is only when one gets back to the steam turbine and boiler plant that one does not find an increase of cost by reason of low power-factor. Even at the turbine and boiler it is necessary to have some extra capacity to take care of the extra line and transformer losses; additional fuel has to be burned, and other expenses incurred merely because the purchaser of power demands a voltage which will vary, let us say, only two per cent between no load and full load.

Few people realize the extent to which motor specifications bear upon the power-factor. The demand for practically constant speed, low rotative speed and great overload capacity, with reasonably low cost of manufacture, all render it difficult to design motors with high power-factors. The air gap cannot be too small without grave danger from mechanical troubles in case of worn bearings; overloads demand large conductor cross-sections, as does close speed regulation; and finally, the demand for a slow-speed motor increases the number of poles and heightens the difficulty of securing a good power-factor. All these points justify a strict control on the part of central stations of the character of motors admitted to their circuits, including in certain instances the refusal to accept connecton with motors of bad design or construction, the installation of synchronous apparatus in important establishments, and in some instances, the imposition of an additional demand charge for poor power-factor. When the charge for current is based either wholly or in part on the demand, it is desirable to measure the demand in kilovolt-amperes rather than in kilowatts. The importance of the power-factor has long been appreciated by operating men, and its consideration on the commercial side is equally desirable under present conditions of central-station expansion.

TELEPHONE RATES.

Considerable attention has been given during the past dozen years to a scientific study of the question of central-station rates, and numerous instances exist today of rates which have been modified from a simple flat rate or measured charge for service, although a thorough-going application of the principles has probably never been made in practice. The same underlying principles apply with equal force to a schedule of rates for telephone service, but the application in this case does not seem to have been generally considered. All, or nearly all, telephone companies make their charges upon a message basis, or else apply a flat rate. In some cases the latter is modified upon a message basis.

Attention is called to an article by Mr. Frank F. Fowle, which is concluded in this issue, in which a study is made of the application of a three-charge rate to telephone service. The three elements of charge considered are those due to the consumer cost, to the maximum-demand cost, and to the traffic cost. The fixed charges and operating expenses are studied with a view to their proper distribution in these three divisions, and the application of the method illustrated by a concrete example.

Just as the use of central-station power is stimulated by an equitable division of the costs among the different classes of consumers, so may telephone service be expected to attract an even wider circle of customers by a restriction of charges for each class to the actual costs incurred for their benefit. A study of the method discussed by Mr. Fowle should be seriously undertaken by telephone managers, with the idea of properly equalizing their charges among various classes of consumers, for the purpose of fairness and the ultimate extension of service. Since the advent of rate-regulating bodies, the tendency has been to make each class bear its proper burden of expense, and this seems a worthy ideal toward which to work.

Jobbers' Association to Meet in Cleveland.

Announcement is made that the February meeting of the National Electrical Supply Jobbers' Association will be held in Cleveland. It had been practically decided to hold the meeting in Buffalo, but a determined effort was made by the Electrical League of Cleveland and in response to direct requests to jobbers all over the country the Cleveland idea prevailed. It is felt that many things respecting the activities of the jobbers point to Cleveland as the logical place for this meeting. Outside of this the electrical interests are already pledged to make the visit of the jobbers highly enjoyable.

Cable Rates Lowered.

Changes in trans-Atlantic cable rates have been made by both the Western Union and the Commercial Cable Company, so as to give cheaper and more generally available service.

The new system of the former company is based on the principle of deferred service represented by the day letter and night letter, and the rates are as follows: (1) Day cable letter, $1.50 for twenty words; (2) week-end cable letter, $1.50 for thirty words; (3) deferred press message, five cents per word.

The Commercial Cable Company will reduce its newspaper rate to five cents a word and the plain-language cablegrams will be hereafter sent at half the former rate. No reduction in the week-end letter nor the deferred cable letter will be made. Negotiations for reducing the cable rate have been under way for about two years.

American Institute Appointments.

The president of the American Institute of Electrical Engineers has announced the following appointments:

Educational Committee: John Price Jackson, chairman, vice A. S. Langsdorf, resigned.

Representatives of the Institute upon the Council of the American Association for the Advancement of Science: J. B. Whitehead and Edward B. Rosa.

Representatives of the Institute upon the Resuscitation Commission: A. E. Kennelly and Elihu Thomson.

Membership Committee: C. E. Scribner, chairman; S. B. Charters, Henry Floy, George W. Lamke, A. A. Miller, N. J. Neall, K. C. Randall, David B. Rushmore, A. M. Schoen, H. Clyde Snook, H. B. Stabler and J. G. Wray.

Advisory Members to Code of Ethics Committee: W. S. Barstow, Louis Bell, John J. Carty, F. B. Crocker, D. C. Jackson, A. E. Kennelly, John W. Lieb, Jr., C. O. Mailloux, Ralph D. Mershon, H. H. Norris, Ralph W. Pope, Harris J. Ryan, Charles F. Scott, Samuel Sheldon, William Stanley, Lewis B. Stillwell, Elihu Thomson and William D. Weaver.

Addition to Power Station Committee: Clyde D. Gray.

Delegate to Eighth International Congress of Applied Chemistry, September, 1912: Charles A. Doremus.

The Standards Committee announces the appointment of C. P. Steinmetz. and B. G. Lamme a sub-committee to collect material looking to the next revision of the Standardization Rules.

The Scope of the National Electric Light Association.

John F. Gilchrist, president of the National Electric Light Association, addressed the members of the Electric Club of Chicago, on December 13, on "The Scope of the Association." In opening Mr. Gilchrist called attention to the fact that there are now 10,000 members in the Association. He said that while this makes the N. E. L. A. the largest organization of its kind in the country, there is still a great opportunity to materially increase the membership. In this connection figures were presented showing the extent of the electrical industry and the number of men engaged in the business.

Mr. Gilchrist spoke briefly of the increasing development of water power and the additional men this development is bringing into the industry. He said that the Association should revise its membership requirements so that every one interested in the business would be given an opportunity to join. This would greatly increase the influence of the organization. Mr. Gilchrist is in favor of changing the name of the Association to National Electric Association.

In reply to a question of Mr. Connelly's, Mr. Gilchrist said that no definite action regarding change of name would be taken at the next annual meeting.

W. E. Keily said that in view of the fact that the Association was founded in Chicago, held several conventions here and had contributed four presidents—more than any other city—Chicagoans should have a peculiar interest in the Association.

H. H. Cudmore, Harry Rice and Professor Bemis also made brief remarks. Mr. Cudmore said that the co-operative newspaper-advertising scheme had recently been enlarged upon, three pages now being run each week in Cleveland.

At the meeting on November 29, F. P. Vose delivered a very able Thanksgiving Day address The meeting on December 6 was devoted to entertainment.

Cleveland Electrical League Gives Big Smoker.

The Electrical League of Cleveland held its third annual meeting and smoker at the Moose Club Hall on Thursday evening, December 7. The earlier part of the evening was devoted to the election of officers for the coming year. The personnel of the new executive body is as follows: David Aitken, president; J. Robert Crouse, first vice-president; L. Griesser, second vice-president; N. C. Cotabish, third vice-president; Peter Yensen, fourth vice-president; T. P. Cagwin, secretary; H. H. Cudmore, A. L. Oppenheimer, G. C. Webster and C. T. McKinstry, executive board.

A large delegation from the Electrical Boosters Club of Pittsburgh was cordially welcomed by the members of the Cleveland League. Among the speakers of the evening who made brief addresses were A. A. Gray, of Chicago, Mr. Harris and Mr. Harrison, of Pittsburgh, and J. Robert Crouse. Mr. Harris emphasized the fact that the getting together of any body of men for the purpose of working out any one aim is one of the greatest assets a community can have. Special attention to entertainment features had been given by the committee in charge. These consisted of orchestra, glee club and mandolin music, vaudeville productions, boxing exhibitions, plenty of good cigars and an ample Dutch lunch. The smoker was characterized by a feeling of good fellowship and informality on the part of all present.

The entertainment and reception features were in direct charge of H. H. Cudmore, retiring president of the league, and no effort was spared to make this the biggest and best treat ever accorded the members and guests of the organization. About 400 attended.

John B. Whitehead.

Modern development of high-tension transmission lines, with a steady tendency toward the use of higher working pressures, has focused attention upon the strength of air as a dielectric and upon the phenomenon of corona. Of importance to the engineer is not only a knowledge of the properties of air and the numerical data which are secured by high-tension experiments, but also the explanation of these phenomena in terms of the ionic and electronic theories which have been developed in connection with the underlying studies of all electromagnetic phenomena. Prominent among engineers engaged in these investigations is John B. Whitehead.

JOHN B. WHITEHEAD,
Professor of Applied Electricity, Johns Hopkins University.

John Boswell Whitehead was born at Norfolk, Va., August 18, 1872. He studied at the Johns Hopkins University, where he received the degree of Electrical Engineer in 1893. After graduation he took a position with the Westinghouse Electric & Manufacturing Company as electrician and remained with them until 1896, when he joined the staff of the Niagara Falls Power Company as operating engineer.

In 1897 he returned to Johns Hopkins as instructor in electrical engineering and advancing through intermediate positions was made Professor of Applied Electricity in 1910. In 1898 he received the degree of Bachelor of Arts and in 1902 the degree of Doctor of Philosophy from that University. He undertook research work for a short period with the Bureau of Standards in Washington, D. C. During the years 1903-1906 he was a research fellow of the Carnegie Institution of Washington. In 1899-1900 he was electrical engineer for the Rowland Telegraph Company, and has served in the same capacity for the Baltimore & Annapolis Short Line Railroad. The design and installation of the electrical equipment of the latter road was carried out under his supervision. Professor Whitehead engages in the practice of consulting engineer in Baltimore, Md.

Professor Whitehead has carried on a number of researches dealing largely with scientific questions of electrical engineering. Among the subjects which he has particularly studied are the inductive electromotive force in transformers, the magnetic effect of electric displacement, reactance in armored cables, the operation of single-phase railways, visual sensation in the magnetic field, the transformation of alternating to direct current and the electrification of steam railways. His most recent work has been a study of the electric strength of air and the conditions governing the high-voltage corona. The two latter subjects have received extensive treatment in papers read before the American Institute of Electrical Engineers.

In addition to his membership in the American Institute of Electrical Engineers, Dr. Whitehead represents the Institute in the council of the American Association for the Advancement of Science. He is one of those who were chosen to give the course of lectures in Illuminating Engineering carried on by Johns Hopkins University in the fall of 1910 in co-operation with the Illuminating Engineering Society. Dr. Whitehead has been very active in the affairs of the Baltimore section of the American Institute; he is the founder of the section and has served as its chairman for some years.

Celestial Electric Phenomena.

Professor Birkeland of Christiana University has been making researches on the nature of electricity and also endeavoring to explain a number of celestial phenomena upon an electrical basis. He has found good warrant for the belief that electric forces operate on the sun, planets, comets, etc., and he is of the opinion that they have played an important rôle in the evolution of the solar system. Part of his latest work is to show how the famous nebular theory of Laplace can be so transformed that the destructive criticism to which the latter has been subjected loses its force. The famous ring of Saturn has been regarded by astronomers as consisting of a multitude of small particles revolving around the planet. Birkeland thinks it almost inconceivable that such a ring of cosmic matter could keep its position indefinitely, especially as it is only thirteen miles in thickness and yet has a diameter of 170,000 miles. His researches have led him to the conclusion that the ring of Saturn is an electrical phenomenon due to radiant matter emitted from the planet, so that the ring is constantly renewed.

His researches also help to explain the sun's corona and zodiacal light. The latter phenomenon shows that the sun must be surrounded by a ring similar to that of Saturn, only that the ring is of far greater dimensions.

The cathode in a discharge tube throws off in considerable quantity the material of which it is composed, especially when the cathode is warm and under the influence of magnetic forces. It is therefore probable that the sun daily throws off considerable masses of matter from its equatorial plane, and that this substance forms part of the radiant matter in the electric ring around Saturn.

THE MEASUREMENT OF INDUCTANCES AND CAPACITIES WITH THE THOMSON DOUBLE BRIDGE.[1]

BY S. J. BARNETT.

While the Thomson double bridge has been used extensively for the measurement of resistances, especially small resistances, it does not appear to have been used hitherto for measurements of inductances or capacities. For these it is often at least as convenient as the ordinary bridge, and in some cases it offers important advantages.

(1) For the comparison of two self-inductances, L and N, the bridge is arranged as in Fig. 1, conventional symbols designating resistances, inductances, etc. When balances have been obtained for both steady and variable currents, $L/N = A/B = a/b$. The branches C and D may be either inductive or non-inductive. The bridge compares the effective inductance between the points 1 and 2 with that between the points 3 and 4 The inductance of the leads is eliminated. The inductance of the central part of a long solenoid, traversed by a uniform current, which is simple to calculate, may be compared with any other inductance, provided that, as is usually the case, $A + B$ and $a + b$ are sufficiently large to insure that the current in all parts of the solenoid is practically the same.

(2) To compare a self-inductance and a capacity, the branch 3-4 is made non-inductive, non-inductive variable resistances r and R are introduced between the galvanometer terminals and the points 5 and 6 respectively, and condensers with capacities s and S are inserted between the upper and lower galvanometer terminals and the points 3 and 4 respectively. A double balance will be obtained when $P/Q = A/B$ $(= a/b)$, $S/s = r/R = a/A$, and $L = SQ\ [A + (A + B)\ /B.R]$.

(3) To compare the mutual inductances M of two coils M and L with the self-inductance L of one of them, L is inserted as in the figure, the branch 3-4 is made non-inductive, and M in series with an adjustable rheostat is inserted between the points 2 and 4. When the double balance has been obtained,

$$\frac{M}{L} = \frac{W}{\frac{P+Q+(a+b)C}{a+b+C}}$$

$= W/$ W designating the total resistance through M between the points 2 and 4.

(4) To determine a self-inductance by comparison with a resistance and a time, one of the coils L in the figure is shunted with a non-inductive resistance Z, and a balance is obtained with an alternating current supply of frequency n. Then

$$L^2 = \frac{Q(P+Z)^2 - PZ(P+Z)\frac{B}{A}}{4\pi^2 n^2 \frac{ZB}{A-Q}}$$

$$N^2 = \frac{\left(Q - \frac{ZPB}{A(P+Z)}\right)\left(\frac{ZB}{A} - Q\right)}{4\pi^2 n^2}$$

If the inductance under investigation is of the kind referred to in the last part of (1), it must obviously take the place of the unshunted coil N in the bridge.

(5) To compare two capacities, the coils L and N are replaced by the two condensers with capacities S and S' respectively. When a balance has been obtained, $S/S' = B/A$.

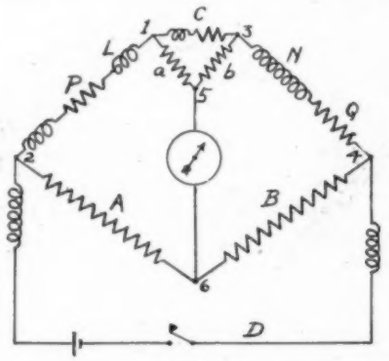


FIG. 1.

Methods (1), (2), (3) and (5) are strictly zero methods. In method (4) only the integral current in the branch 5-6 vanishes, except for a certain definite relation between all of the inductances present, which may be made to exist by addition of an inductance variator in series with one of the coils.

In all the above methods the positions of the generator and detector may be interchanged without altering the balance. If the points 1, 3 and 5 are made to coincide, these methods (and many other double-bridge methods which will immediately suggest themselves) reduce to well-known Wheatstone-bridge methods. The double-bridge methods described here have all been tested in the physical laboratory of the Ohio State University, and the theoretical formulas have been verified experimentally, but the bridge has been used only in the ordinary form in which $A = a$.

[1] Abstract of paper read by title at meeting of American Physical Society, Chicago, December 2, 1911.

Bell Company Buys Independent Systems.

The New York Telephone Company has, through a recent merger, acquired control of all the independent telephone companies in New York State with the exception of the State Line Telephone Company and the Federal Telephone Company, operating in Buffalo and vicinity.

The companies acquired are the Commercial Union Telephone Company, operating in Troy, Glen Falls, Saratoga, Lake George and other points in that vicinity, the Albany Home Telephone Company and its subsidiary, the West Shore Home Telephone Company of Catskill, the Cohoes-Waterford Telephone Company, the Renssalaer Home Telephone Company, the Schenectady Home Telephone Company, the Citizen's Standard Telephone Company of Kingston and vicinity, the Dutchess County Telephone Company of Poughkeepsie and the Independent Union Telephone Company and the toll line system connecting those plants.

The number of telephones involved is 26,000 and the system has several hundred miles of toll lines. The price paid for the properties is in the neighborhood of $3,000,000.

National Civic Federation to Investigate the Regulation of Utilities.

The Executive Committee of the Department on Regulation of Interstate and Municipal Utilities of the National Civic Federation is prepared to make an exhaustive investigation of the problems involved in the work of the department. Committees have been appointed on rates, on control of service, on control of capitalization, on franchises, on accounts and reports, on safety of operation and on ways and means. The Committee on Franchises includes in its membership H. M. Byllesby, Samuel Insull and Thomas N. McCarter. The Committee on Rates includes Theodore N. Vail. Charles L. Edgar, Charles A. Stone and U. N. Bethell are on the Committee on Control of Service.

Membership of Commonwealth Edison Section, N. E. L. A., Rapidly Increasing.

During the month of November the Commonwealth Edison Section, N. E. L. A. received 164 applications for membership. For the same month in 1910, 78 applications were received.

Chicago's New Automatic Telephone System.

Construction and Operation of the Equipment.

The new automatic telephone system that has been placed in operation in Chicago this year is of considerable interest for several reasons. It makes this city the largest one to have automatic telephone service and it is asserted by those who have installed it and are rapidly extending it that before many years Chicago will have the largest automatic installation of any city in the world. The new system also makes Chicago the largest city that has active competition between two telephone systems, each of which is connected with toll lines and furnishes both local and long-distance service. All of the equipment in the new system is of the latest automatic type and embodies many distinctive features; moreover, it was installed in exceptionally rapid time.

The automatic system was installed for and is being operated by the Telephone Department of the Illinois Tunnel Company. As suggested by its name, this company operates an extensive system of deep tunnels under substantially all of the streets in and near Chicago's main business district. These were built in the last decade by tunneling under the streets without disturbing their surfaces. These tunnels[1] for the most part are 7.5 feet high by six feet wide inside; they lie with their floor line on an average of forty feet below street level. Their total length is over sixty miles. In the tunnels is operated an electric trolley line equipped with 117 250-volt mining locomotives and 3,000 trailer cars. It handles all kinds of freight to and from depots and warehouses, and also various bulk materials such as coal, ashes, excavations, etc.

Although these tunnels accommodate the freight service chiefly, they also serve as underground ducts for the new telephone cables in the downtown district. In fact, this was generally believed to have been the primary object of their construction, the right to operate a freight service having been granted by an ordinance amending and broadening the original franchise. In conformity with the franchise requirements, an independent telephone system was installed in the central business district and placed in operation in 1903. It was one of the first Strowger automatic systems to be put in service and had one central exchange on Fifth Avenue near Monroe Street.

For a number of reasons, however, it was not actively developed and was allowed to fall into a sort of dormant condition for several years. One of these reasons was purely financial. Another was that the manufacturers of automatic telephone equipment were rapidly improving it and therefore it was realized that, on the verge of some very important developments in this line, it would not be expedient to keep on enlarging the original installation with equipment that was about to become obsolete.

One of the franchise requirements was that 20,000 telephone subscribers be connected with the system by a certain date. This had been extended several times, and was finally set for June 1, 1911. Early in 1910 it became apparent that aggressive action was necessary to meet this requirement. It was therefore decided by the receivers of the Illinois Tunnel Company to proceed at once with the active development of the telephone property. A preliminary study quickly disclosed the fact that this meant more than a complete rehabilitation, and that it would be necessary to start from a new basis and build a substantially new plant.

FIG. 1.—WEST EXCHANGE.

FIG. 2.—PLYMOUTH EXCHANGE.

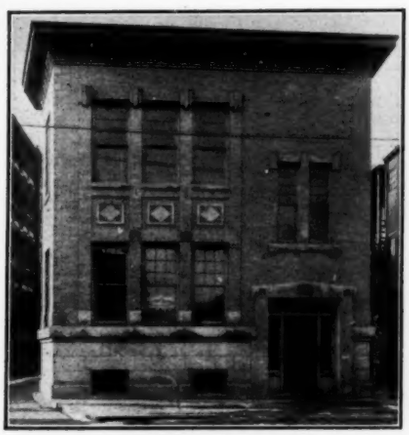


FIG. 3.—NORTH EXCHANGE.

PLAN AND CONSTRUCTION OF THE NEW SYSTEM.

As soon as the necessary financing had been arranged for, a most capable engineering staff was organized and its work was begun early in May, 1910. A detailed inspection of the entire old system was first made. As a result of this it was decided to "junk" nearly all of the old equipment aside from the wire plant. A development study of the central business district showed that it would be much more desirable for the growth of its telephone traffic

[1] See WESTERN ELECTRICIAN, May 16, 1908, page 386, for an illustrated description of the tunnels.

to provide four exchanges instead of only one as before. The exchange centers were located for the four quarters of the district, and one or more floors leased for each in buildings most available thereto.

While these exchanges were being planned, the development study was being gradually extended to the south, north and west, first among the manufacturing and wholesale districts adjoining the center and later among the smaller business houses and residences outlying. Four outlying exchanges were located in these districts, two of which were to be subexchanges first.

In all the plans for the new system the idea was carried out of providing an automatic system of the latest type and capable of ready extension so as to serve ultimately several hundred thousand subscribers in all parts of the city, to whom long-distance connections with independent toll lines were to be made available. An all-cable wire plant was decided upon, with cables in the tunnels downtown and in underground conduits outside the tunnel area, poles to be used for aerial distributing cable only.

The construction of the new plant was undertaken with vigor. The contract for all the automatic telephone equipment was awarded to the Automatic Electric Company. The Subway Telephone Construction Company was given the contract for the installation work. A large construction force of the most experienced men in their lines was quickly organized. The actual work was begun in the central business district, several gangs working simultaneously in the four new exchanges, on the rearrangement and new installation of the cables in the tunnels, and of the equipment of subscribers' substations. As soon as the downtown work was under way, similar work was begun in the outlying districts on the exchanges, underground conduits, distributing pole lines and substations. Throughout the construction period new records for speed were established, as is shown by the remarkable summary of one year's work in installing, connecting, testing and putting into service wire plant as follows:

821,000 duct-feet of conduit.
165,000 feet of 25-pair cable.
320,000 feet of 50-pair cable.
102,000 feet of 100-pair cable.
71,000 feet of 200-pair cable.
190,000 feet of 400-pair cable.
60,000 feet of 600-pair cable.
110,000 feet No. 19-gauge 200-pair trunk cable.
500,000 feet of messenger strand.
1,500,000 feet of drop wire.
2,270,000 feet of interior wire.

THE WIRE PLANT.

In the tunnel district the cables originally installed were found to be in excellent condition, and it was therefore decided to utilize them as far as possible for the new system. As there were to be four exchanges at new centers in this area to take the place of the original single office, this necessitated moving most of the old cable. This was a doubly difficult task, because it had to be done without interrupting the transportation service in the tunnels, and also without discontinuing telephone service to several hundred subscribers still connected with the old exchange.

The general arrangement of the cables on the roof of the tunnel is shown in Fig. 4. The trolley wire is covered by a deep inverted wooden trough to protect the cables on either side of it from damage due to a trolley jumping off the wire. Lateral cable connections to adjoining buildings are of two kinds. Where the building has a tunnel entrance to its sub-basement the lateral follows this. Most of the buildings, however, are connected through iron-pipe laterals as shown at the right in Fig. 4. In the original installation the cable terminals in laterals were placed in recesses in the tunnel walls; on account of dampness and inaccessibility these were all relocated in the basements of the buildings.

Outside the tunnel district 200 miles of multiple-duct vitrified-clay conduit have been laid. This is all of standard construction and is entirely embedded in concrete. The manholes are brick-lined with concrete floor and roof. All the cable for subscribers' lines has No. 22 B. & S. gauge wire. Interoffice trunk cables are equipped with No. 19 B. & S. gauge wire. Subscribers' lines are limited to a loop resistance of 300 ohms.

Pole lines are built in alleys and a few side streets for supporting distributing cable only. As shown in Fig. 5, the entire absence of cross-arms and general rugged construction gives these lines a neat appearance. All poles are of seven-inch-top cedar and receive two coats of paint. The messenger strand is extra strong and supports the cable by means of marline cable hangers. The drop wires to subscribers' premises run from the cantop terminal box over doubly grooved

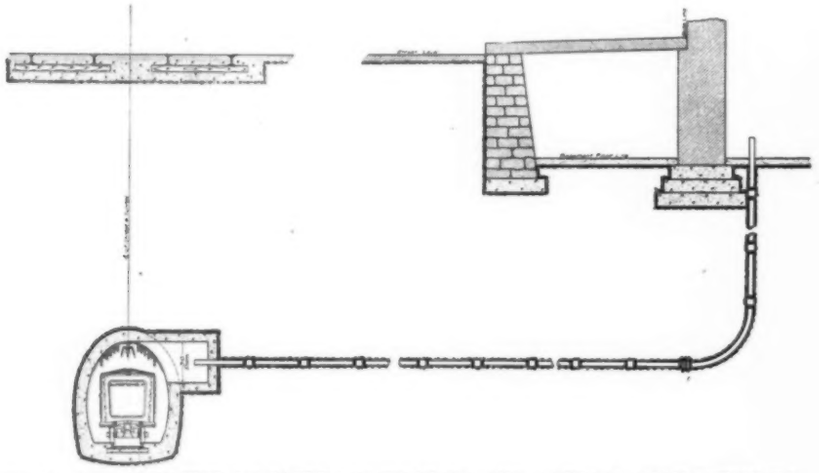


FIG. 4.—ARRANGEMENT OF CABLES IN TUNNELS AND LATERAL CONNECTION TO BUILDINGS.

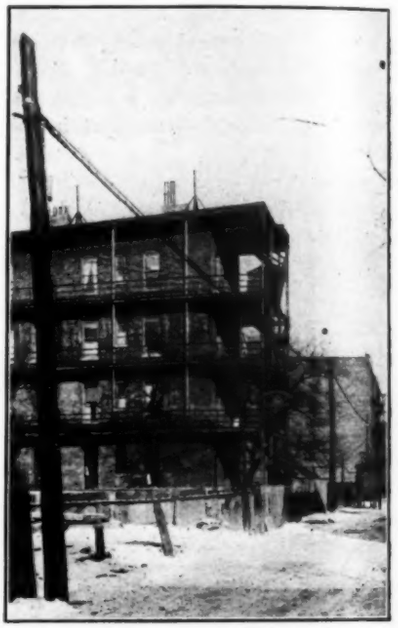


FIG. 5.—TYPICAL DISTRIBUTING POLE LINE IN ALLEY.

porcelain knobs on special brackets along the sides of the pole. All drop wires are twisted pairs of rubber-covered and braided copper-clad steel wire.

EXCHANGES.

The location of central offices or exchanges is such that each is situated at the telephonic center of its district. As the development proceeds and becomes dense enough in an outlying part of the district to warrant the establishment of a center of its own, a branch office is first created at the new center. This becomes a suboffice of the principal exchange of the district until such time as the development of the business makes it desirable to change the branch into a regular district office. This plan results in great economy in length of subscribers' lines.

On account of high cost of real estate in downtown Chicago, the four exchanges in this area were established in leased quarters, each occupying as a rule two floors in its respective building. These exchanges are as follows: Chemical, Chemical Building, 117 North Dearborn Street; Chronicle, Chronicle Building, 175 West Washington Street; Plymouth, Automobile Club Annex, 319 Plymouth Court; Brooks, Brooks Building, Jackson Boulevard and Franklin Street. In the outlying districts the exchanges, with one exception, are located in buildings that were built by and are owned by the Illinois Tunnel Company. These exchanges are as follows: Cottage Grove, Thirty-Ninth Street and Elmwood Avenue; West, Monroe and Paulina Streets; North, La Salle Avenue and Maple Street; Yards, 4170 South Halsted Street. The two latter offices are branch exchanges, the North office being a suboffice of Chronicle exchange, and the Yards office being a suboffice of Cottage exchange.

The arrangement of all the exchanges is exceedingly compact, particularly in the downtown offices, where floor space is quite valuable. Despite this, all the equipment is systematically laid out and entirely accessible from all sides. Provision is made so that additional equipment can be readily installed. A typical exchange layout is shown in Fig. 6, which is the main floor plan of the West exchange. Of course, the details of arrangement vary in the different exchanges to suit the local condition. In several of them the power plant is located in the basement or on a separate floor.

The power equipment for each exchange, such as shown in Fig. 7, comprises duplicate motor-generator sets for charging a large storage battery, duplicate ringing machines for ringing on individual lines, and duplicate harmonic ringers for the party lines. There are also two toll-tone sets and a completely equipped switchboard.

The standard potential of the system is forty-eight volts and the source of the main current for operating automatic switches and for other purposes is a twenty-five cell storage battery in each exchange that is used during both charge and discharge. As the voltage obtained from the battery must be kept close to the standard during both discharge and charge, a set of seven counter-electromotive-force cells is provided for cutting in one by one as the charge proceeds; this is done by means of a rotary end-cell switch on the switchboard (see the second panel from the left in Fig. 8). On the board is also mounted a Weston high-voltage and low-voltage relay alarm, which rings a bell in the main room of the exchange when the voltage varies two volts above or below the standard. All the cells in the battery have considerable free space for the addition of more plates to increase their capacity. The cells are mounted in the standard manner in lead-lined wooden tanks. All the batteries were furnished by the Electric Storage Battery Company. Each battery room has a well drained concrete floor and is entirely shut off from the rest of the exchanges; special ventilating equipment is provided for this room.

The charging machines consist of a direct-current or alternating-current motor of fifteen or twenty horsepower, depending upon the location and size of the exchange. The motor is direct connected to a sixty-five-volt, compound, direct-current generator provided with a specially large field rheostat for giving a wide voltage adjustment. Current for the charging and ringing sets is obtained from the mains of the Commonwealth Edison Company. The ringing machines are of standard type and are provided with a special load-distributing device so as to operate for the different thousand-line groups in succession and thus provide a substantially constant load for the machine. Two small toll-tone sets are provided in each exchange which automatically furnish to the long-distance operators individual tones to identify the calling line as being a private line, prepayment line, party line, or as a leased wire. The switchboard, aside from having the necessary switches,

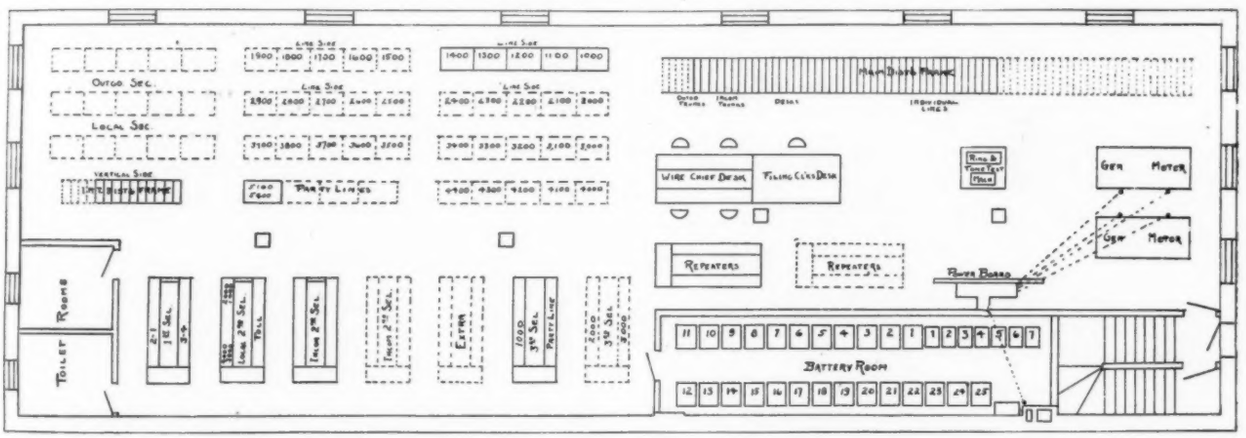


FIG. 6.—TYPICAL EXCHANGE LAYOUT—FIRST FLOOR OF WEST EXCHANGE.

instruments and rheostats for controlling the machines and the main exchange currents, has a complete equipment of fuse alarms. The switchboards are of Tennessee marble and present a handsome appearance.

The space limits of this article do not permit going into more than a general description of the automatic switching equipment of the exchanges. Since the principles of automatic telephony have been explained in a number of papers[2] within the last few years, only a brief review of the main features of operation will be attempted here. For the most part the Chicago installation is quite similar to that installed a few years ago in San Francisco. Although the equipment seems very intricate, it operates with extraordinary speed and precision. When one conceives the magnitude of the problem involved in automatically selecting a called line from among tens of thousands in different exchanges without the intervention of any human agency beyond the will of the calling subscriber, the speed with which the connection is established and the absence of errors are truly marvelous achievements of the ingenious design of the automatic switching machines.

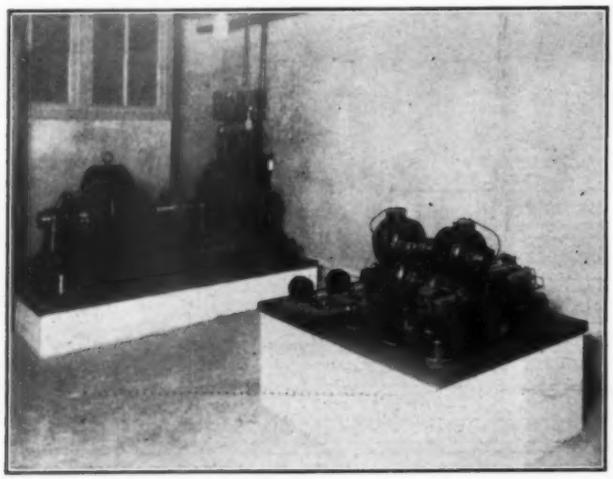


FIG. 7.—PART OF POWER PLANT, PLYMOUTH EXCHANGE.

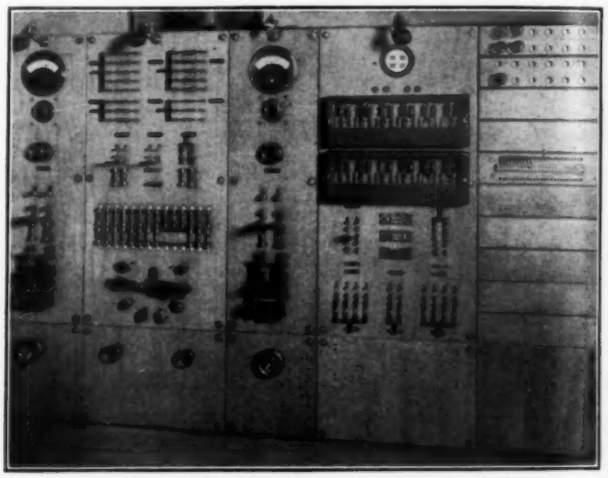


FIG. 8.—POWER SWITCHBOARD, PLYMOUTH EXCHANGE.

Six or seven automatic switches are involved in nearly all connections. These are primary and secondary line-switches, first, second and third selector switches and connector switches, for local calls in the same exchange; for calls to another exchange an additional secondary line-switch is used. The subscribers' lines are terminated from the entering cables on the main distributing frame, where the usual protective devices are installed, and the lines regrouped for connections to the primary line-switches, of which there is one for each individual line.

These line-switches are mounted in groups of fifty, as shown in Fig. 9. They have a rotary motion and preselect an idle trunk as soon as the calling subscriber removes his receiver from the switch-hook. The contact fingers, or wipers, sweep over horizontal banks of trunk contacts arranged in the arc of a circle. As soon as any trunk is engaged for one of the lines, the wipers of all other switches in the group are advanced to the next idle trunk by means of a master magnet. Fifteen trunks are available to each double group of line-switches, or 100 lines. The trunks from the primary line-switches are carried to secondary line-switches. The latter are similar to the primary switches and are arranged in groups of thirty, that have access to ten trunks leading to first-selector switches. The object of both sets of line-switches is to reduce the required number of the more expensive first-selector switches; thus, in the Chicago installation 100 of the latter serve 2,000 lines.

A first-selector switch, which has by means of the line-switches been automatically connected to the calling line by the mere action of taking the receiver from the hook, is actuated by the first turn of the subscriber's calling device corresponding to the first digit of the number called. This first figure is characteristic of a particular district exchange, all the 10,000 numbers connected to which commence with that figure; consequently the first selector picks out an idle trunk to that exchange. This it does by stepping up to a level of bank contacts corresponding in number to the number of impulses received from the first turn of the dial; the release of the dial causes the first-selector wipers to swing horizontally along the contacts in that level until they find a pair for an idle trunk. If the number called is in the same exchange, this trunk leads directly to the second-selector switches therein. If the number called is in another exchange, the trunk leads to another line-switch that immediately picks out an idle interoffice trunk to the called exchange, where the connection is completed by second and third selectors and a connector.

The second turn of the calling dial operates a second-selector switch which works in exactly the same way as the first selector, but picks out an idle trunk to the particular thousand group desired in the exchange. In the same way the third turn of the dial operates a third selector to pick a trunk and connector to the particular one hundred group desired in that thousand. The last two turns of the dial actuate the connector switch, which steps up to the desired ten level and on the last impulses turns to the actual line called. This completes the connections and the bell of the called line is automatically rung so that conversation may proceed. If the called line is busy, the usual busy tone is imposed on the line. All the selector switches are of the type shown in Fig. 10, and they are mounted in groups of 100 in glass cabinets.

2 Transactions, American Institute of Electrical Engineers, 1908, page 503; 1910, page 55; 1910, page 357.

The connector switches are mounted on the reverse side of the line-switch racks, ten regular connectors and four test connectors serving a unit group of 100 lines. Room is left so that additional connectors up to fifteen may be mounted on each frame. For party lines, which are usually assembled in another section of line-switches, there are twenty regular connectors and one test connector for each group of 100 lines, mounted as stated before on the reverse side of the primary line-switch frame for those 100 lines.

Private-branch-exchange lines are also assembled in a particular section and have fifteen regular and one test connector actually mounted, with room for the addition of five more connectors if the traffic demands require it. The reason for mounting connector switches with the primary line-switches is to facilitate wiring, because each of these types of switches must be connected directly to the subscribers' lines. Talking current is supplied to a called line from the connector switch that establishes the connection to that line. If the calling line is connected with another exchange, talking current is supplied through repeaters to the calling line at the point where the trunk leaves the exchange.

Each of the switch groups is provided with a number of automatic protective devices and alarms. Above each rack is mounted a series of colored lamps for indicating if a switch fails to release, or if it fails to complete the connection, or if other troubles develop during operation. At the same time that one of these lamps is lighted an alarm bell rings at a central point in the exchange and lights a similar lamp at that point, thus indicating to the switchman the exact character of the trouble and its location. This facilitates the location of difficulties, so that most troubles that develop are detected immediately in the exchange before the subscriber has actually been made aware of them.

In each exchange there is a wire chief's desk arranged somewhat like that shown in Fig. 11. It is arranged for four positions, although in some of the exchanges only two of these are equipped. The desk is of the latest type and has a full complement of meters, plugs and keys, so as to make the work particularly convenient and rapid. Instead of requiring to connect to the distributing frame in testing out a line, the wire chief has test connector switches mounted, as already stated above, on each line-switch unit. By means of these any line can be picked out with a minimum of time and assistance. A number of direct circuits connect the various wire chiefs in the different exchanges so that they can readily communicate with each other without going through any of the automatic switches.

The equipment described above relates to the six principal offices of the system. The suboffices, Yards and North, do not have first and second-

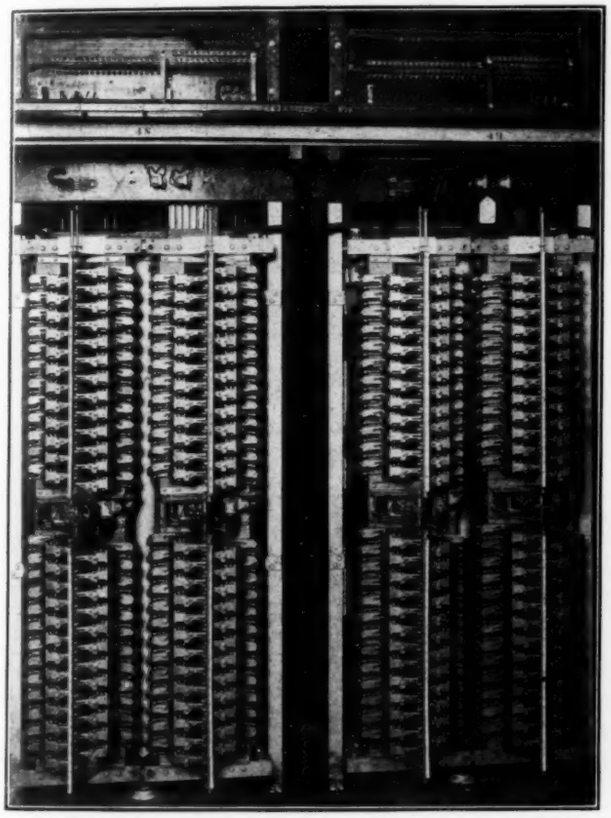


FIG. 9.—TWO GROUPS OF PRIMARY LINE-SWITCHES, PLYMOUTH EXCHANGE.

FIG. 10.—A GROUP OF FIRST-SELECTOR SWITCHES, PLYMOUTH EXCHANGE.

selector switches, for these are installed in the exchange to which they are tributary. The suboffice has a certain number of thousands of the 10,000 assigned to its district exchange and is therefore equipped merely with primary and secondary line-switches, third selectors and connectors. Room is provided, however, for the complete equipment of each of the suboffices into regular district exchanges.

SUBSCRIBERS' EQUIPMENT.

The equipment at the subscribers' stations is of the latest standard automatic type with the two-wire calling

device. There are no grounds whatever on the system thus eliminating external disturbances. The desk stands look like the ordinary desk telephones, except that they have a small calling dial mounted obliquely above the base. The wall sets are very compact; one of them is shown at the right in Fig. 10. The operation of the calling device by successively turning the dial to the stop from the finger holes corresponding to the desired number has already been referred to; the entire calling operation is very simple and for a five-digit number need not take much over as many seconds. The ringing of the called party is entirely automatic. By merely hanging the receiver on the switch-hook all the automatic switches are restored to normal thus making the telephone immediately available for another call.

The party-line equipment is similar to that for individual lines, except that the bells are tuned for particular frequencies for selective ringing. The harmonic converters already referred to and shown under the covers on the right-hand panel of the switchboard in Fig. 8, provide ringing frequencies of 16, 33, 48 and 66 cycles for four-party lines.

Prepayment equipment for four-party lines and public paystations has the coin box integral with the telephone set, and in the wall prepayment set even the bell is mounted in one compact unit. In making a call from a public paystation, the receiver is removed from the hook and the call put through by means of the dial in the ordinary way. As soon as the called subscriber answers, the calling party deposits a coin in the coin box. Until this is done the transmitter at the calling station is short-circuited so that the calling party is not able to transmit his message until his coin has been dropped. The connector switches that lead to long distance, information, complaint, fire and police lines are equipped so that they do not establish this short-circuit on the transmitter at a paystation, thus these calls are made without interruption and are entirely free. The short-circuiting of the transmitter is a very positive and time-saving device, as it avoids the call of an operator to deposit a coin and insures that this act is done before any message can be sent over the line.

The automatic system is adapted to any type of private-branch exchange. These are principally of two types, those requiring a local operator and those that are entirely automatic. As shown in Fig. 13, the former are quite similar to those commonly in use in manual systems, except that the operator has a calling device which she can connect to any of the trunks and use for calling the number wanted. The branch telephones are usually of the ordinary type, although a calling device can be readily provided for any of them so as to enable such lines to be connected direct to the trunk for night use or in the absence of the operator.

A purely automatic private-branch exchange, such as shown in Fig. 14, consists of a set of line-switches, first selectors and connectors. The local telephones have three-digit numbers with 1 as the first digit. From a local telephone one can call any outside telephone by prefixing the number 2 to its directory number. The branch telephones are listed in the directory with six-digit numbers. At the district exchange an additional fourth selector is provided for automatic private-branch-exchange lines. If any of the branch telephones should not have access to

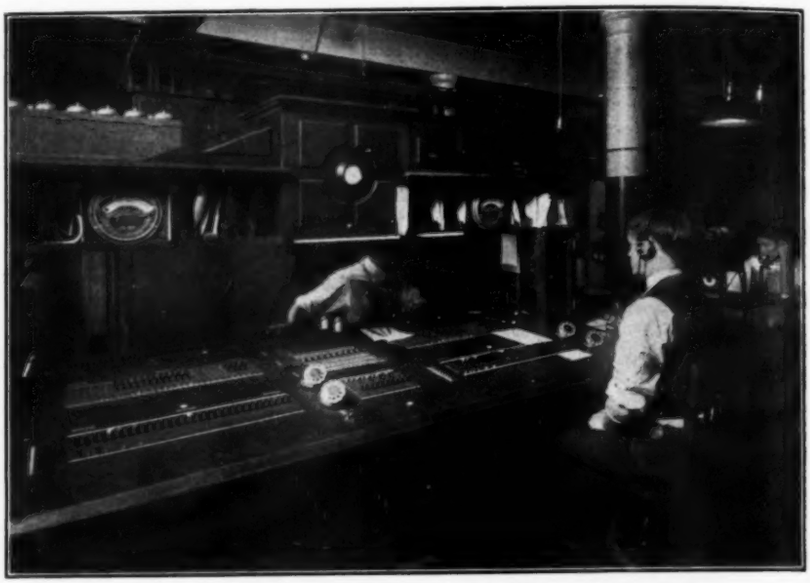


FIG. 11.—WIRE CHIEF'S DESK, CHRONICLE EXCHANGE.

FIG. 12.—INFORMATION AND COMPLAINT DESK WITH THREE TELAUTOGRAPHS.

outside connections they are readily arranged for local service only.

SERVICE.

Practically all kinds of service customary in any large exchange are provided by the Chicago automatic system. This includes individual lines, private-branch exchanges with several trunks, special or leased lines, two-party and four-party lines, public pay-stations, etc. The latter provide prepayment nickel service. Aside from this service and long-distance calls, all of the service provided is on a flat-rate basis.

An interesting feature of the Chicago system is the establishment of a service department which has charge of inaugurating new features and of doing everything possible to advance the character of the service provided.

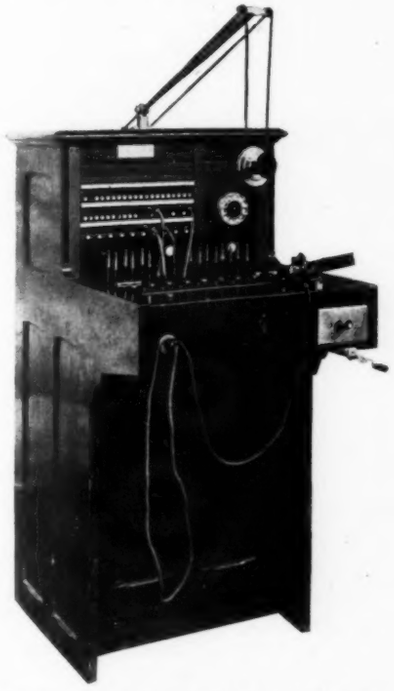


FIG. 13.—MANUAL PRIVATE-BRANCH EXCHANGE WITH AUTOMATIC CALLING DEVICE.

To supply information and to take care of complaints is an important feature in any telephone system. In the Chicago automatic system this is amply provided for. The information and complaint desk is located at the Chronicle exchange, which is one of the most central in the system. All calls for information can be obtained by calling the number 392, and complaint calls are obtained by calling 393. Thus, 100 numbers are set apart for each class of these calls. At the present time ten information and ten trouble trunks are connected to the desk, which is shown in Fig. 12.

A very simple and effective system is used for distributing the load among the four clerks in charge. Any incoming call causes lamps to light in each of the four positions, and the first idle operator answers the call. The first choice is designated with a white lamp, the second with a red, and third and fourth by green lamps. Five information trunks lead to the first and five others to the third position, where they are represented by white lamps. In the second position the first five are represented by red lamps, and in the third and fourth by green lamps. The second group of five trunks is represented by red lamps in the fourth position, and green lamps in the first and second. The complaint trunks have white lamps in the second and fourth positions, and red and green lamps in the other positions arranged similarly to the information trunks. This arrangement has been found to distribute the calls very satisfactorily and permit rapid answering of them without overburdening any of the clerks. The information clerks have access to three complete card indexes of all the subscribers of the system; these are arranged on the opposite side of the room and provide a classification of subscribers by name, number and address.

When a complaint is received the complaint clerk writes it out in code form on a telautograph, three of which are shown in the upper portion of Fig. 12. The written message is instantaneously transmitted to the clerk at the wire chief's desk in the exchange that must investigate the complaint. The receiving telautograph is shown at the right in Fig. 11. This use of the telautograph eliminates the loss of complaints and errors in their transmission. This is the first time that the telautograph has been used for this purpose.

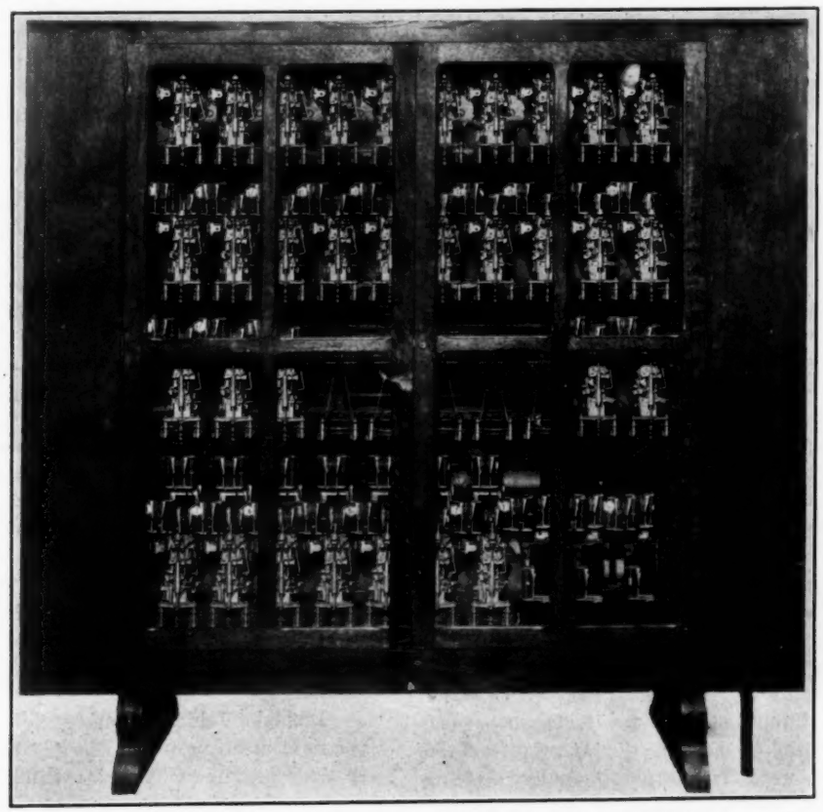


FIG. 14.—COMPLETELY AUTOMATIC PRIVATE-BRANCH EXCHANGE.

To save the trouble of answering repeated calls for the time of day, an arrangement is now being perfected whereby a phonograph will announce the time every five seconds. The records will be automatically changed every ten minutes. By calling the number 360 any line is automatically connected to a microphone transmitter opposite the phonograph.

This "chronophone," as it is called by its inventor, H. D. Stroud, of the Illinois Tunnel Company, is arranged to permit special news service to be given over the same lines. By pushing

a key the announcer can cut off the microphone at the phonograph and simultaneously cut in a master transmitter on the outgoing circuits. Special news announcements, such as serious accidents, fires, etc., can be given out as soon as received from the telegraph or press offices; if the latter is the source, this will be announced so that people can immediately send out for the special edition giving further particulars. By adding sufficient trunks and switches any number of people can get the time and news at once.

A long-distance board has been installed in the second floor of the West exchange. This handles all long-distance calls received over the automatic lines. The switchboard is similar to most manual toll boards, except that it embodies a number of interesting innovations for facilitating and simplifying the putting through of toll calls. Each operator's position is wired to serve ten toll lines. Each operator has an automatic calling device to enable her to reach any of the automatic subscribers. In the exchanges the special test connectors used by the wire chiefs are also available for use by the long-distance operators, so as to enable them to set up a local connection but to avoid ringing the bell of the calling party until the long-distance connection is complete. The toll board has two sections each equipped for two positions for recording clerks. A very simple record system is in use. A special desk is provided for the chief operator and monitor.

Long-distance connections have been established with the Interstate Telephone & Telegraph Company, through which access is had to the exceedingly numerous independent lines in the Central and Western States. Twenty-five trunks at the present time leave the exchange and are carried in No. 19, No. 16 and No. 13 wire pairs through underground cable to the city limits at Twenty-Second Street and Forty-Sixth Avenue, where the connection to the Interstate lines is made. Special rates for long-distance service are provided for calls between 7 p. m. and 7 a. m., these night rates usually being about sixty per cent of the day rate. Five minutes is the minimum long-distance call instead of three minutes as in the Bell system.

This article would not be complete without referring to the excellent character of the service provided by the Chicago automatic system. Its speed has already been alluded to, but in this connection a casual test made by a switchman at the Brooks exchange may be of interest. While observing the operation of the line-switch connected to a broker's line, it was noted by means of a stop watch that four complete calls, in each of which a message was transmitted, had been made in a period of sixty-five seconds. Although no measured service is provided, overloading of lines has not been noticed to any extent. The elimination of disconnects, wrong numbers, and other troublesome features of manual service have found hearty approval from the Chicago public, who have taken very kindly to the entire automatic system.

Municipal Ownership.

In discussing municipal ownership, the *Electrical News* winds up with the following very pertinent statement:

"Summed up, the strength of municipal ownership is private corporation arrogance; its weakness is municipal incompetence and political interference. There are unmistakable signs that the private corporations have profited by their experience and in many cases have learned to treat the public justly and even generously. This is coming to be recognized as the modern business method. There are also signs, equally unmistakable, that much of the glamor of municipal ownership has been dispelled, in many quarters, by a few years of actual experience."

Electric Vehicle Meeting.

The next meeting of the Electric Vehicle Association of America will be held in the Engineering Societies Building, New York City, on December 19, at 8 p. m.

Stephen G. Thompson, of the Public Service Corporation, Newark, N. J., will present a paper entitled "Is Central Station Activity Justified in the Electric-Vehicle Field?"

Convention of Northwestern Cedarmen.

The annual meeting of the Northwestern Cedarmen's Association will be held in Minneapolis, Minn., January 23 and 24, 1912.

Exports of copper for the week ended December 7 were 8,641 tons. The figure given since December 1, is 8,641 tons, as compared with 6,408 tons for the same period last year.

Electric Power Generated at Garbage-Disposal Stations.

Garbage destruction, according to a paper read by Etienne de Fodor, before the Turin Congress, first began in an industrial way in England in 1870. The English type of disposal furnace has compartments lined with fire brick, with grates formed of iron plates or bars. To effect complete combustion jets of air or steam are employed, the grates being cooled by jets of water or air.

In England there has been such a remarkable development in this line that London alone now has fourteen garbage incineration plants. The total number of installations in that country is 192.

On the Continent the first plant was put in at Hamburg in 1892, and its example was followed by Brussels, Zurich and Stockholm. In these plants, however, as in the older English ones, the only thing desired was the destruction of garbage, without any secondary aim.

At present the advantage of making use of the superfluous energy in the generation of electric power is being realized more and more. Lord Kelvin and Professor Forbes dwelt with especial force on the fact that from one kilogram of garbage material at least 1.5 kilograms of steam could be generated. The most obvious use of this steam is, of course, in connection with the generation of electrical energy.

As far back as 1896 the city of Oldham, England, built its generating plant in the vicinity of the garbage-incinerating station and with one boiler supplied 120 horsepower for outside use while another boiler took care of the power needs of the station. The first similar installation in a city of the first class was made at Shoreditch, London, and the success was such that other plants soon followed their example.

While in that country the incineration of garbage seems to be well adapted to existing conditions the scheme has met with less success on the Continent. Variation of the quality of the material itself requires the use of furnaces of different form and it is harder to get results even with special apparatus. One difference is that in English practice air is blown under the grate at a comparatively low pressure (60 to 100 millimeters of water), while in Germany five or six times this pres-

sure is used. This is necessary to insure every particle of combustible material being reached. Grates of the bar variety are not used, their place being taken by troughs in which the material is dumped. Air is blown in through holes in the sides of these troughs. The troughs are not large, and are charged often, the object being to produce as perfect combustion as possible and to leave but little burnable ash. Economizers and special refillers are used to prevent the loss of heat so considerable in the old types. Even the small amount of heat in the ashes is utilized by blowing over them the air which enters the furnace. Removal of the cinders, one of the most disagreeable operations in connection with the work, should be done automatically, and the refuse should be taken out in solid form instead of being previously broken up.

POWER OBTAINED FROM SEWAGE INCINERATING PLANTS OF SEVERAL CITIES.

CITY	Boilers Heated by Garbage			Engines		Kilowatt-hours generated	Consumption of Plant Kilowatt-hours	Power Distributed Kilowatt-hours	Use of Power
	N	Heat'g Surface Sq. Meters	Type	No.	H. P.				
Frankfort	6	750	Horizontal water-tube	2	1,000	2,290,143	377,039	984,316 614,310 314,478	Municipal lines. Water system. Water purification.
Barmen.....	3	420	Vertical fire-tube	1	600	1,400,000	300,000	1,100,000	Municipal system.
Brünn	2	424	Horizontal water-tube	2	675	809,062	138,615	670,447	Municipal system.
rederiksberg.	3	615	Horizontal water-tube	2	340	496,187	193,885	120,869 2,919 125,514 53,000	Municipal hospital Water system. Private lighting. Loss in lines and batteries.
Zurich.....	3	410	Horizontal water-tube	1	220	180,347	130,751	36,473 13,123	Furniture factory. Shops.
Kiel.....	3	510	Horizontal water-tube	1	80				

Following out these principles new garbage incinerating plants were built at Wiesbaden, Mickolcz, Kiel, Brunn and Frankfort, all using the isolated chamber system. The development of the continuous grate method, however, still goes on and plants of this kind have been put in at Paris, Ixelles, Le Havre, Rouen and Milwaukee. A large installation of this kind is being put in at Rotterdam, Holland.

Exceptional care has been taken in choosing a method of charging the furnace, and instead of doing this work by manual labor automatic devices have been largely employed. Plants which have taken advantage of this more modern system are to be found in St. Petersburg, Zurich, Furth and in a number of English cities.

The Continental plants differ from the original English type and are an improvement because of the stimulus of lively competition. The garbage disposal stations are more sanitary and more successful from an industrial standpoint inasmuch as they are so constructed as to insure good combustion and to give a good quantity of steam per kilogram of garbage. In the new Continental establishments it was decided from the first that they should be employed as an adjunct for the generation of power, and for this reason the furnaces were not primarily considered as garbage destroyers, but as means of operating steam plants.

THE CALORIFIC VALUE OF GARBAGE.

It is quite easily seen that the value of this inferior quality of combustible varies according to season and to local circumstances. Where considerable coal is burned the value of garbage from residential districts is good. Conditions of English towns where good coal is burned are, for instance, better than in Continental cities where lignite of an inferior quality is used. Household garbage in England as a general thing contains a good deal of unburned coal, because open stoves are generally used, while on the Continent there are a greater number of coal stoves employed.

In Berlin a considerable quantity of lignite briquette is burned and as a consequence there is but little combustible residue, a fact which makes the garbage of Berlin of less value than that of any of the other cities of Germany. Moreover, ashes left from these briquettes are injurious, as they envelope the combustible material contained in garbage and prevent its economic consumption. If the briquette ashes were taken out of the Berlin garbage it would without doubt be of greater value.

The calorific value of the household garbage varies greatly in different quarters of the city, being of course, best where there is a rather congested district. It might even be said that it is the best in the poorest portions of the city. The greater part of such products as straw, cloth, bones, leather, etc., comes from these quarters. The poorer people also leave more coal in the ashes than the better class of establishments because of the defective grates used in the cheaper kinds of stoves. Moreover the cheaper coal has more of a tendency to form clinkers.

The heating value varies also with the diet of the inhabitants. Thus, the German garbage is about one and one-half times as rich in vegetable material as that of English cities.

With the various seasons the amount of heat obtainable also changes. In summer the calorific value is lower not only because of the lack of coal ashes, but because the material thrown away contains a large amount of moisture, as, for instance, discarded fruit, vegetables, greens, etc. In Budapest, the amount of melon rinds, corn husks and similar material thrown out is the most remarkable feature. The same phenomena is found in New York City, and in a good many other American cities, where vegetable material forms at least a fiftieth part of the household garbage, and here also melon rinds and corn husks form a very considerable part.

A chart of the disposal station of Frederiksberg shows the variation of humidity according to the season. The amount changes between about twenty-one and forty per cent of the total weight, the minimum being reached in winter and the maximum in summer.

In some English cities an amount of steam obtained from burning the garbage is sufficiently high to classify this as a good combustible.

From other statistics the conclusion may be drawn that in a greater part of the Continental cities where coal is used to any extent in the household at least one kilogram of steam to each kilogram of garbage may be calculated upon. This is a figure which the furnace builders guarantee without restriction and which they exercise every effort to obtain in practice.

OPERATION.

To secure advantageous and above all constant operation every effort should be made to secure uninterrupt-

ed generation of heat and to avoid every possible extinction of the furnace, because reheating causes considerable waste of fuel.

To accomplish this end all possible care should be exercised in charging the furnaces so that the combustible will be equally distributed throughout the day. This makes possible a production of current in accord with the outside uses for power and the needs of the plant. In the evening current can be used directly for lighting, while during the rest of the day it can be employed advantageously in charging storage batteries which furnish current for the needs of the plant, such as the operation of blowers, pumps, ash removers, etc. The surplus can be distributed through the outside network.

Continuous combustion, of course, means the continuation of steam. The more the combustion is restrained and the smaller the number of furnaces, the greater will be the oscillations of output caused by the variations in steam pressure. As the calorific value of the garbage varies not only daily but momentarily, it is necessary to take account of continual fluctuations, and it is in this connection that the storage batteries have their greatest value. Equalization of pressure can also be brought about by a reserve heating plant which can be instantly put in operation when required.

In some stations arrangements have been made so that the steam is kept up at night with coal exclusively, garbage being employed during the rest of the time. Oil is also used as a reserve combustible.

It is quite natural that the steam obtained cannot be used in the most economical way in the ordinary steam engine. Unfortunately nearly all the steam engines installed up to the present time in the garbage incinerating plants waste a considerable amount of the energy which is furnished to them.

A very important necessity is that of keeping the power requirements of the plant itself as low as possible. Power necessary for the pumps should be reduced to a minimum. Apparatus connected with making the ashes commercially useful should be made to consume power to as good advantage as possible. Without this control a plant can easily consume thirty per cent of the energy which it produces, while another installation with apparently the same circumstances only consumes about fifteen per cent of its total output.

The table on page 1231 gives some idea of the results obtained in a number of Continental garbage-disposal plants.

As to the most convenient place for a garbage incinerating plant, it might be said that it would cause somewhat less inconvenience in the outskirts of the city, although in any case it would be less of a nuisance than many manufacturing plants. Several examples which follow give some indication as to what has already been done. For instance, in London there are several stations in the center of the city; at Gloucester there is a disposal plant directly across from the cathedral; in Dublin, Glasgow, etc., the plants are in the manufacturing district. At Brussels the disposal plant is near the depot of the North Railroad.

The odor produced is as a general thing practically negligible, for the material is heated in a closed furnace to such a high temperature that every particle of organic matter must necessarily be consumed. The hot gas escaping from the stack is equally inodorous, and contains only a small per cent of ammonia and hydrogen sulphide. Hardly any black smoke, such as is perceptible in manufacturing districts, is seen, only a little cloud of yellowish color being visible. This comes from the condensation of the hot gas meeting the cold air, and is really only condensed water vapor.—*Translated from La Lumiere Electrique.*

LETTERS TO THE EDITOR.

Electrocuting Insects.

To the Editor:

Seeing the letter from Mr. Duryea in your issue of December 2 reminded me of my observations of the effects of high-tension lines on insects.

While in charge of a 100,000-volt transformer station I frequently noticed that there were large numbers of dead insects adhering to the leads of transformers, switches and to the porcelain inlet bushings, also there were a great many in the gaps, between the cylinders of the 2,200-volt arresters.

It appears that when these insects get within a short distance of the high-voltage wires they are violently attracted, just as dust is attracted by high-voltage lines.

R. H. PICKENS.

Clemmons, N. C., December 4, 1911.

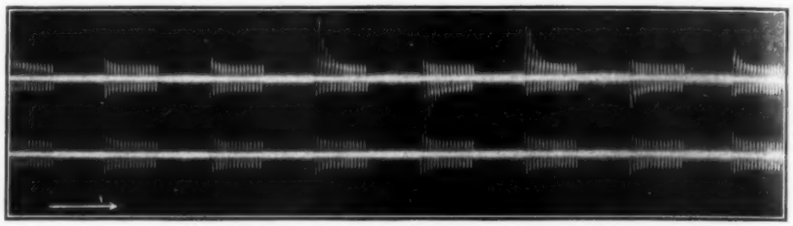


FIG. 1.—PRIMARY AND SECONDARY CURRENTS OF TRANSFORMER ON FLASHING-SIGN CIRCUIT.

Meter Registration on Flashing Sign Circuits.

To the Editor:

Referring to your issue of November 11, page 990, it is apparently there stated that a watt-hour meter when used to measure the energy consumed by sign lamps does not register correctly if a flasher in the circuit operates above a certain speed; the error in registration becoming very great with tungsten lamps and rapid flashing up to 120 per minute; the error disappearing at 20 flashes per minute and below. It did not seem that such metering would be subject to such large errors; therefore, some experiments were made

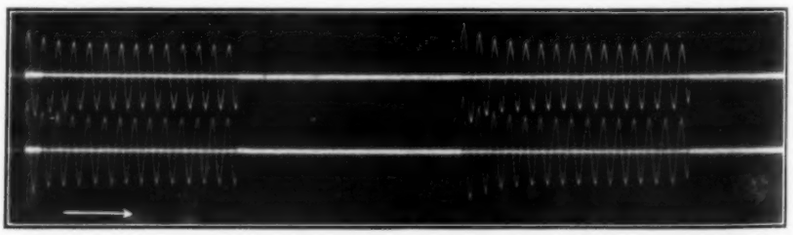


FIG. 2.—DETAILS OF TWO SINGLE FLASHES—PRIMARY AND SECONDARY CURRENTS.

with an oscillograph to determine whether such errors existed, and in general how large these errors were.

A type "I," five-ampere, 110-volt meter was connected in series with the primary of a 500-watt, 60-cycle, sign-lamp transformer. 100 five-watt, twelve-volt, Mazda sign lamps were connected to the secondary of the transformer. A flasher arranged to make and break the circuit, having the time of break approximately equal to the time of make, was also connected into the primary. The speed of the flasher could be varied from 120 to 10 flashes per minute. The oscillograph was arranged to show primary and secondary current in the sign-lamp transformer.

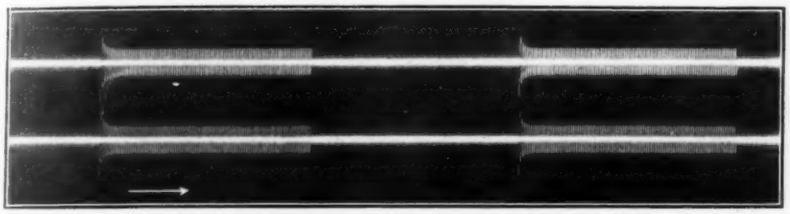


FIG. 3.—RECORD OF SINGLE FLASHES MADE AT THE RATE OF TWENTY PER MINUTE.

The accompanying oscillograph records were made, accompanied by meter readings. All the observations were made on a sixty-cycle circuit of approximately sine wave.

		Meter Reading.				Excess
	Flashes	Flasher				shown
Fig. No.	per minute	running.	Flasher stopped.	Ratio.	Ratio flasher.	by meter.
1	120	285	505	.564	.515	1.10
2	120	284	505	.562	.515	1.09
	60	270	500	.540	.515	1.05
3	20	256	490	.522	.515	1.015
	120	270	490	.551	.515	1.07
4	120	265	480	.553	.515	1.075

Column 1 gives number of oscillograph record.
Column 2 gives number of flashes per minute.
Column 3 gives reading of watt-hour meter, flasher running.

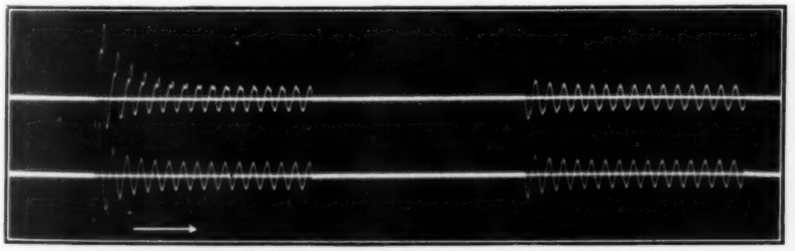


FIG. 4.—SHOWING DIFFERENCE IN MAGNITUDE OF CURRENT ON FIRST AND SECOND FLASHES, DUE TO FILAMENT COOLING ONLY PARTIALLY.

Column 4 gives reading of watt-hour meter, flasher stopped.
Column 5 gives ratio of readings, running to stopped.
Column 6 gives ratio of time that current is on when flasher is running to the time of one complete operation of the flasher.
Column 7 gives ratio of meter reading, flasher running, to meter reading that would be obtained if the resistance or power consumption of lamps did not vary during the flash. This is equal to column 5 divided by column 6. This includes current rush on make in addition to any meter error.

Fig. 1 shows the variation between successive primary rushes into the transformer. Fig. 2 shows the details of a single flash to larger scale. From this the form of the curve can be more clearly seen. Fig. 3 is a similar record on 20 flashes. In each of these figures the upper curve is primary current and the lower curve secondary current.

Fig. 4, page 990, in the issue referred to shows time-watt curve of a tungsten lamp. The question may be raised as to why the oscillograms taken do not show a correspondingly large current rush when the circuit is first made. The explanation is that the lamp filaments do not become cold between flashes. Fig. 4 on this page shows the difference between the first and second flash at 120 flashes per minute.

From the table it may be seen that the excess of meter registration, due to change of resistance of lamps, does not exceed 10 per cent and this 10 per cent would appear, from a rough estimate of the oscillograph records, to correspond to the actual excess of energy shown in the last column.

On account of the fact that a large number of oscillograph records would require to be measured and computed, in order to determine from the waves actual energy consumption for comparison with the meter, this comparison has not been attempted. With considerable expenditure of time and the information given in the various figures the energy could be determined with a fair degree of accuracy. It is certain that any discrepancy cannot amount to more than a few per cent, if there is any at all.

L. T. ROBINSON.

Schenectady, N. Y., November 29, 1911.

Poisonous Automobile Exhausts.

To the Editor:

I have read with great interest the article on "Poisonous Automobile Exhausts" in your issue of December 9.

From it I gather that the result is due to the quantity of lubricating oil used in the cylinders of the engine. Most oil companies claim that the best oils contain twenty per cent hydrogen and eighty per cent carbon, and that the burning of the hydrogen sets free the carbon, which causes the smoke from the exhaust, the smutting of spark plugs, etc. Am I to understand that this carbon is in the form of a monoxide and an aldehyde, which contain a lot of poison? There are several mixtures on the market which are highly recommended for reducing the oil consumption and afford better lubrication; one of the foremost of these is oildag, a graphite paste.

Would it not be valuable to the health of the public for you to highly recommend, after a thorough investigation, the use of one of these products, as a means of relieving the public of this poisonous nuisance?

H. GRAU INNISS.

Atlanta, Ga.

The editors of this journal cannot undertake to investigate all the lubricants on the market and discriminate between them. Such experiments as have been made by others indicate that gasoline motors cannot be operated under practical conditions without emitting poisonous gases. While some of the carbon is deposited in the elemental form, some is also set free in a combined form, and not completely oxidized. Obviously the best way to avoid all possibility of contaminating the air is to use electric motors in place of gasoline motors.—EDITOR.

White Way For St. Joseph.

The city of St. Joseph, Mo., is to have an ornamental electric light installation along seventeen blocks of its main street. The poles are to be made by local foundries and the installation is in the hands of the St. Joseph Light, Heat & Power Company.

The Southern Railway is erecting two metallic telephone circuits along its right of way between Knoxville and Chattanooga, and station equipment will be installed for dispatching trains by telephone.

New York Meeting of the American Society of Mechanical Engineers.

At the annual meeting of the American Society of Mechanical Engineers, held in New York, December 4-8, a number of papers of considerable interest to the electrical profession were offered. These included papers on boiler practice, power transmission, the application of electricity to the cement industry, and one paper on the textile industries of the United States. This latter opened a discussion which centered largely on the electric-motor drive, and with it questions of power supply were brought up, which led to a rather sharp debate between the advocates of isolated plant and central-station.

BOILER PRACTICE.

The two papers on boiler practice presented were entitled, "Tests of Large Boilers at the Detroit Edison Company," and "Strain Measurements of Some Steam Boilers Under Hydrostatic Pressure." These papers were written respectively by D. S. Jacobus and James E. Howard. An abstract of Professor Jacobus's paper was given in these columns in the issue of November 18, page 1038.

In the discussion it was questioned whether the concentration of 2,365 boiler horsepower in such units was altogether wise, inasmuch as the failure of one tube in the boiler would operate to put a large percentage of the boiler power of the station out of service. Against this liability of accident may be charged the high economy obtained, which the tests showed was due in a large degree to the size of the unit, which permitted large combustion spaces. The possible economy, it was held, more than overbalanced the comparatively slight risk of tube failure. Other points brought up in the discussion were those of maintenance, repairs and operation. By the use of large boilers, a small fireroom force may be maintained and other complications of the plant greatly reduced.

On the operating side, problems are introduced which are not met with smaller units. Where a boiler of the size of those used at Detroit supplies steam to a single 6,000 or 7,000-kilowatt turbine, the shutting down of the turbine necessitates the blowing off into atmosphere of from 75,000 to 100,000 pounds of steam, which is a serious matter. Means must be taken to protect the boiler by the injection of feed water in large quantities in order to reduce the temperature in the boiler. In order that the disturbance of the steam capacity can be reduced to a minimum while the highest pressure is being maintained, it is necessary that an arrangement be developed for a graduated feed, which will closely follow the demands for steam on the boiler. In these large units, fluctuations in the supply of feed water are apt to lead to large fluctuations in pressure, when the boilers are operated singly. By the use of a graduated feed the stresses on the boiler, due to expansion forces, will be considerably reduced.

In regard to boiler economy, an extensive discussion was presented by Professor William Kent, who said that the most notable features of these boilers was the enormous size of the combustion chamber, the grates being about 10 feet below the lowest point of the heating surface and the total height of the furnace being about 29 feet. Construction of this character represents good practice which should be followed in the future as it fills all the conditions for maximum boiler economy. The great size, however, requires the best possible brickwork and tubes, workmanship of the best quality, treatment of the feed water before it enters the boiler, and severe measures to prevent the entrance of oil or grease. In order to study the efficiency, the efficiencies obtained in the various tests were plotted and a formula developed for a curve. Its equation is

$$E = 81 - 1.33\ (w/s - 3)$$

in which E designates the efficiency in per cent, w the number of pounds of water evaporated per hour from and at 212 degrees and s the square feet of heating surface in the boiler. The line defined by this equation indicates approximately the ratio of the efficiency to the rate of driving for the ten best results out of sixteen tests. The sixteen tests were plotted in relation to this line and it was found that six tests with the Taylor stoker were close to this line and one 2.8 per cent below it. Four tests with Roney stokers were close to the line and five ranged from 1.4 to 2.8 per cent below it. A study of the reason for the deviation of these tests from the line of maximum efficiency revealed that the most important variable affecting the economy was the difference in air supply, and the most important conclusion to be drawn was that the air supply must be kept down at high rates of driving so that the pounds of dry air per pound of combustible does not exceed 18. The ratio of w/s is important in this respect, and when this ratio equals 7 an increase in the amount of dry gas per pound of combustible from 18 to 20 pounds means a drop in efficiency from 73.9 to 69.9. If the quantity of dry gas per pound of combustible increases beyond 20 pounds, and w/s increases above 7, the drop in efficiency increases much more rapidly. This indicates the need of gas analyses to control the regulation of the air supply, which need is imperative at high rates of driving. These tests settle the question as to whether it pays to drive boilers at high rates, beyond the usual point of commercial maximum fuel economy, since they show what loss in economy may be expected at high rates of driving. The loss in fuel due to rapid driving may be more than offset by the reduction in interest on the investment.

A remarkable fact in connection with the Detroit boilers, was the unusually high efficiency obtained. The running efficiency of seventy-five per cent, including a layover period of seven hours, with a load ranging from 100 to 200 per cent of rating, means much in power-station work. Based on a turbine developing one horsepower on 220 British thermal units per minute and with a brake-to-switchboard ratio of 1.5, it means 26,000 British thermal units in fuel per kilowatt-hour, or about 1.9 pounds of coal. The high economy shown was obtained at a rate as high as seven pounds evaporation per square foot, and in a city power station the cost of land and buildings and the interest on them will be approximately in the inverse ratio of the rates of evaporation. The big boiler is efficient commercially as well as thermally.

A comparison of the results obtained at Detroit with other record tests led to the conclusion that, practically considered, the large steam plant is thermodynamically equal to the gas engine. Oil engines of course excel, but they are limited by the practicable size of unit that can be installed, and therefore the same degree of economy of labor and materials cannot be realized with the internal-combustion motor. This leaves them altogether out of the domain of the large power plant. The comparison no longer holds true for small equipment, as the internal-combustion motor gives quite uniform efficiency over a large range, while there is considerable

variation in the efficiency of the steam plant, depending on the size.

The paper by Mr. Howard on "Strain Measurements on Steam Boilers Under Hydrostatic Pressures," described hydrostatic tests made on two horizontal tubular boilers, which had been in service for a period of twenty-seven years. Gaged lengths were established on different parts of the boiler by means of holes about 0.05 inch diameter, reamed to a conical shape and spaced 10 inches apart. The deformations of the boilers were determined by a 10-inch micrometer strain gage with conical points to fit the reamed holes laid out on the boilers. The paper gives by means of diagrams and illustrations, the strains occurring at the locations where the measurements were taken. For the sake of comparison stresses were computed using modulus of elasticity of 30,000,000. The strains were least in amount at the head and in general greater rigidity was displayed at the intermediate girth seams than in the solid sheets. At the middle of the length of the longitudinal seams, the maximum extensions were developed. The extension of this type of tests to other classes of boilers would seem desirable and might assist in establishing satisfactory rules for steam-boiler construction and might reasonably be expected to aid in the framing of regulations governing allowable pressures.

ELECTRICITY IN THE CEMENT INDUSTRY.

Two electrical papers were presented at a session devoted to the cement industry. One entitled "Confirmation of the Advantages of Electricity to Cement Manufacturers," was prepared by J. D. Porter. The other, "Electrical Power in the Cement Plant," was by F. H. Lewis.

Mr. Porter's paper gave the advantages of electricity in accordance with information obtained from cement manufacturers. Cement machinery has grown to enormous sizes in the past few years and electricity has played an important part in this growth. It is difficult to give a comparison of the costs of operation of plants equipped with electrical and mechanical drive, because it seems impossible to find two operating under the same conditions. Records were presented where the power consumed on a tube mill under ordinary commercial conditions, varied from 112 to 160 horsepower, due to the weight of pebbles in the mill. By means of electricity, this trouble was immediately corrected. Certain plants which have introduced mechanical drive in their main driving departments, with motors only on the auxiliary, did this on the theory that since the use of electric drive interposes between the prime mover and the mills, the generator and transmission lines and motors with their attendent losses, which are replaced by the main belt and line shaft, the economy of the latter should be higher. This may be true with a good mechanical transmission with a minimum of shafts and belts, but there are a number of compensating advantages to the electric drive which tend to raise its ultimate economy as compared with the engine drive. The most important of these is the fact that no plant operates at a constant load so that the transmission losses which may be only a small percentage of the mechanical system at full load, are really a considerably greater proportion of the actual power produced; while with the electrical system, the losses are reduced much more nearly in proportion to the reduction in load. The average load factor of a number of plants is only about eighty per cent. The electric drive suffers practically no deterioration in efficiency after installation, while, the mechanical transmission does. Another point in favor of the economy of the electric drive, is that steam turbines may be employed as prime movers, these showing a higher economy at all loads than engines and requiring less attendance and supplies. The greatest advantages, however, is the flexibility. In a mechanically driven plant, extended repairs on an engine can only be made by shutting down the plant, while with a properly designed electrical generating station with three units, any two of which can, with a slight overload, carry the entire plant, repairs can be made at any time while the plant is in operation. The possibility of flexibility in operation with motors needs no comment. The induction motor is better fitted to deliver constant speed to the mills than any other form of drive, since it is not affected by fluctuations in the voltage or by heating. Without the individual drive it is necessary to equip the mill with friction clutches always a source of trouble and annoyance. The ease and accuracy with which power can be metered and apportioned between the different departments with the electrical system, is an advantage of which the cement engineer makes frequent use in locating trouble and reducing cost. Data obtained by the use of indicators with mechanically driven plants, are subject to inaccuracies and are apt to lead to erroneous conclusions.

The opposite side of the question was presented by Mr. Lewis in his paper, who admitted the flexibility of the individual motor drive but who considered that the engine-driven plant gave the best results in mills of large capacity. The disadvantages of electric power according to Mr. Lewis are high initial cost, which compared with an engine-driven plant was as 2 to 1, or in the most favorable circumstances 1.5 to 1; high operating cost, the writer figuring that in a completely equipped electrical plant, the consumption of coal per barrel of cement will be at least ten per cent greater than in the engine-driven plant; limited overload capacity, since the regular line of alternating-current motors takes in starting a heavy current at least twice what is needed when running under constant load. Under certain conditions as much as three times the current may be required, and in a small plant may drop the voltage considerably, throw out the circuit-breakers and jolt the whole transmission. Even in large plants it is necessary often to dispense with circuit breakers on the starting side of motor switches or else equip the circuit breakers with an inverse time element relay.

OIL ENGINES.

At another session two papers on oil engines were read by H. R. Setz and by F. M. Towl.

Mr. Setz's paper was devoted to a description of the Diesel engine and its modifications, commonly known under the collective name of constant-pressure engines. The description was in the form of a critical discussion leading to an explanation of the principles underlying the processes of fuel injection. Particular attention was given to the development of comparatively small units.

Mr. Setz added to his paper curves which show the relative economy of the Diesel engine compared to other types of petrol and gas engines, which showed the points at which it is uneconomical to use the Diesel engine.

Mr. Towl's paper described a test of a De la Vergne oil engine, operating an oil pump, and one of the same engines operating under the same conditions but having the load applied by a Prony brake instead of a pump. The object of the test was to find the friction of the pump and gearing and the efficiency of the plant. The pump and transmission efficiency were 92.1 per cent. The total station efficiency was 25.52 per cent, and the duty per 1,000,000 British thermal units was 198,664,000.

An inquiry as to the maximum thermodynamic efficiency of the oil engine brought forth the reply that the efficiency based on indicated horsepower was about 45 per cent; which gave a thermodynamic efficiency based on brake horsepower of 33 to 35 per cent. Several speakers cautioned against too great enthusiasm in regard to the possibilities of the oil engine, and especially cautioned those manufacturers of gas and steam engines who were proposed to enter the oil engine field. Fits, clearances and other similar allowances necessary in steam-engine construction have by this time become matters of common knowledge, but the same allowances have yet to be learned for oil engines. This can only be accomplished by means of a series of more or less expensive experiments. If these experiments are not carried out, the same knowledge will be acquired, but through the far more expensive course of engine-room failures.

TEST OF A 1,000-HORSEPOWER NATURAL-GAS ENGINE.

Another paper presented was entitled, "Tests, Construction and Working Cost of a 1,000-kilowatt Natural-Gas Engine," by E. D. Dreyfus and V. J. Holquist.

Most of this paper centers about the manner in which the testing of a large gas engine in commercial service was successfully conducted, and is supplemented by data relating to the economies realized in both construction and operation. In view of the care necessary to obtain dependable results, it is shown how all observations were critically taken in order to minimize the "personal" and "instrumental" error which may appear in such work. Parts of the paper, dealing strictly with the examination for errors, have been abridged in publication. All important details of the tests are embodied, together with the precautions followed in the use of the various measuring instruments. The simplicity of the plant details, and the facility in starting and standby service, are also evidenced. As a final measure of the value of the installation, the cost of producing current with this type of equipment has been determined, including all operating expenses and charges incident to the investment.

This paper provoked but little discussion. It was stated that when this engine was first considered, it was decided to design an engine to operate on natural gas, but which could also operate on producer gas should the natural gas supply become exhausted or so expensive that producer gas would be a more economical operating medium. Attention was called to the extremely low operating cost, which, it was explained by one of the authors, were due to local conditions.

THE ELECTRIC MOTOR DRIVE IN TEXTILE PLANTS.

This paper, which outlined the conditions existing in the textile industry of the United States, and which was written for a

committee on textiles of the society, by Frank W. Reynolds, led to a totally unexpected discussion of the electric motor drive. The reference in the paper itself to the power and transmission problem was comparatively brief and consisted chiefly of an amplification of the statement of the writer's belief that when power can be taken from the flywheel of the engine by a short direct drive, to the head shafts of the mill, such form of transmission is preferable to the electric drive. But wherever there is a scattered group of mills and the transmission shaft has to make angles, electric transmission is more desirable. As usually arranged in the mechanical drive, an average of 72 to 74 per cent of the indicated horsepower of the engine reaches the machine. With motors arranged in group drives, 65 to 70 per cent is delivered to the machine, while with the individual motor drive, the figures are 70 to 75 per cent. The virtue of electrical transmission which largely counterbalances its lower efficiency is its continuous speed. The advantage of the motor is most apparent in the individually motor-driven machine, where the speed is even because of the positive action of the motor. The relatively low efficiency of the small motor, seems to be the chief weakness of the individual drive, so far as regards efficiency of power transmission.

In the discussion which followed the presentation of the paper, the advocates of the motor drive cited the well known arguments in its favor, of unobstructed light, freedom from dust and greater cleanliness in the workroom. The advocates of belt driving insisted that all these advantages were secured in textile mills by under-driving where power was taken from shafting along the floor below the machines by means of belts to the machines. The objection to belt drive so far as lighting was concerned, was disposed of by the statement that unless the ceiling was depended upon to reflect light down on the machines, the presence of belts close to it made but very little difference in the light of the room.

Considerable comparison between the group drive and the individual motor drive was indulged in. Calculations were presented which had been made for a new mill for both individual-motor and group drive. The high first cost of the individual motor compared with the cost of comparatively large motors used in the group system, made the former system prohibitive. However, when the cost of shafting, couplings, pulleys, hangers and belting was included with the motor cost in the group drive, but little difference in the initial cost was shown between the two systems, and if there was added to the cost of the group drive the extra power required to drive the friction load, resulting from long lengths of shafting and many bearings and belts, the balance appeared to be well in favor of the individual drive. In defending the belt drive, one speaker stated that one of the reasons why the individual motor drive was considered superior to belting, was the alleged inefficiency of belts. This efficiency he claimed, however, was due to neglect of rules for the proper design of belt drive, and stated that if belts were laid out with the proportions given by Taylor and Barth, which called for much heavier belts than are commonly found in mills of any character, the efficiency of belt drives would be fairly comparable to electric motors.

In regard to the source of power for electric driving, the advocates of both central-station power and of the isolated plant had considerable to say. The governing principle was developed that the ultimate cost of power should decide the source from which power was obtained. This, it was shown, was largely a question of locality. Thus in New England it is necessary to maintain an auxiliary steam plant for heating purposes during the winter months. No comparatively great investment would be required to extend the plant to one of such size as would be capable of driving the mill, especially since the cost of power represents but a small percentage of the actual total cost of manufacturing.

Should water power be near, the decision would not be so easy, and the difficulty of obtaining coal at that particular locality would have much to do with the question of power supply. In the Southern States, where the problem of heating is not such a large factor, the decision may be made more easily, particularly if a hydroelectric power station is within reasonable distance of the plant.

Various industries of Charlotte, N. C., were instanced as an example of a locality where eminently satisfactory service was being obtained from the central station. Practically every factory in that city is driven by electricity generated at the plant of the Southern Power Company. It was questioned, however, whether a steam generating plant could give such good service and completely dominate an industry as has been done at Charlotte. It was stated in answer to this that the low cost of electric power in a steam-driven plant was principally a matter of engineering, and that electric power was produced at the steam-driven plants in Chicago much more cheaply than it was sold in Buffalo from the waterpower plants of Niagara Falls.

VARYING THE SPEED OF ALTERNATING-CURRENT MOTORS.

DISCUSSION BY AMERICAN INSTITUTE AT NEW YORK.

The two hundredth and sixty-sixth meeting of the American Institute of Electrical Engineers was held at the Engineering Societies Building, New York City, on the evening of December 8. President Gano Dunn, in introducing the author of the paper to be discussed, said that the inherent isochronism of speed of all electric motors without the use of governors or extraneous devices is a most valuable property we are apt to lose sight of. However, the constantly increasing requirements for control ability, adjustability and variability of speed in alternating-current motors is concentrating the attention of engineers on the subject. A paper broadly reviewing the achievements in this line was therefore particularly timely.

Gus A. Maier then presented an abstract of his paper on "Methods of Varying the Speed of Alternating-Current Motors."

VARYING ALTERNATING-CURRENT MOTOR SPEED.

Mr. Maier's paper takes up the general discussion of the methods that have been proposed for varying and adjustable-speed work with alternating-current motors. For varying-speed work the following types of induction motors have been used: squirrel cage with primary resistance and with primary compensator control, double squirrel cage with movable starter, sliding armature type, and polar-wound armature type; in commutator motors both the resistance and brush-shifting repulsion motors have been used. For adjustable-speed work the following motors have been used: pole changing, frequency changing and cascade-connected multispeed induction motors; shunt repulsion, and induction motor in connection with shunt-repulsion commutator motors.

The starting torque of an induction motor is directly dependent on the rotor resistance, the slip and the square of the voltage, and inversely on a function of the resistance, slip and reactance. Where primary control is used with squirrel-cage motors either by resistance or compensator the motor must be large and therefore expensive. Sliding-armature control and the double squirrel-cage motor have the same limitations. The polar-wound induction motor with variable resistance in the rotor circuit is best adapted to variable speed, as the losses necessary to obtain reduced speeds are external to the motor itself; the latter is, therefore, of a very compact form. Further advantages of this type are the very much better inherent speed regulation, the line current is less, the slip also is less, the power-factor higher and the efficiency relatively high throughout the entire range.

Taking up the operation of commutator type, single-phase motors, the author considers briefly the driving of a direct-current motor with alternating current. When alternating current is used a compensating winding is almost invariably necessary. Va-

rious methods of obtaining compensation are described. The motors invented by Elihu Thomson, by Winter and Eichberg, and La-Tour, were described. With regard to speed control these motors can all be considered as equivalent to the direct-current series type.

Mr. Maier then briefly discusses primary-voltage control, primary-resistance control, field control, and armature-voltage control. Brush-shifting commutator motors are built for both single-phase and three-phase circuits. The first of these is described in some detail. It is of the type known as the Deri, and is used for hoists, railway work, and in such places where a motor with series characteristics is required. The machine possesses speed, current and speed-torque characteristics of the direct-current series motor. A motor arranged for brush shifting must be built larger than one with stationary brushes.

Multispeed operation is designated by the author as relating to those types of induction-motor speed control in which two, three or four definite speeds suffice for normal work. In these motors the different synchronous speeds are produced by changing the number of poles in the magnetic circuit. Each of these speeds is fixed, if no resistance is used in the rotor circuit. By including the latter a truly multispeed motor is obtained. The number of poles may be changed in three ways: (1) by the use of single magnetic and electric circuits, and changing the number of poles by regrouping the coils; (2) by the use of single magnetic circuits and independent electric circuits; (3) by means of separate magnetic and electric circuits. For the first of these a speed ratio of greater than 2 to 1 is not suitable because the wiring becomes too complicated. With the second method it is usually impracticable to use more than two windings, although by combining both the first and second methods four speeds may be obtained. Where the motors are of large size these two methods are objectionable where it is desired to change the speed frequently, therefore the third type is generally used with cascade connection. Two motors are connected in direct concatenation if they have a tendency to start in the same direction, and in differential concatenation if they tend to start in opposite directions. The operation and control of cascade sets is simple. An internally concatenated motor has recently been developed in England. It seems to possess a number of marked advantages.

Where a large number of speeds is not required, a simple speed control may be used by means of a frequency-changing set. It involves high initial cost and large speed steps, which moreover must be made with the motor stationary. The author then takes up the consideration of the adjustable speed single-phase motor, going into its theory at some length and alluding also to the Alexanderson type. The polyphase commutator motor is described and various illustrations of it given. The paper concludes with a description of the Kraemer system and a method devised by Scherbius, which have found considerable vogue in Europe.

H. W. Buck opened the discussion by stating that there is a popular notion that it is necessary to convert alternating-current supply into direct current to obtain the speed flexibility of direct-current motors. That is not true, for recent developments in the variation of speed of alternating-current motors which have not yet become of general knowledge afford an opportunity for the use and application of such motors for industrial purposes, which are almost as flexible as those afforded by the highly developed direct-current motor.

W. M. Smith asked which of the methods described in the paper have actually been tried on a commercial scale and found satisfactory.

Mr. Maier replied that at the present time in this country there is only one type of adjustable-speed alternating-current motor which is used, that is the multispeed motor, which is used to a limited extent. In Europe there have been used the adjustable-speed single-phase and three-phase commutator motors. The slip-ring motor is used in some cases where the torque is constant and continuous, such as for wheel lathes or boring mills; the slip-ring motor must be run with constant load.

Carl J. Fechheimer described the alternating-current motor brought out by Hyland and Rudenberg in Europe. It is somewhat comparable to the Scherbius and Kraemer systems. We know nothing about the operation of any of these systems at the present time in America, and it is very difficult to get information, but it would appear from the length of time which has been required to successfully design direct-current apparatus and get satisfactory commutation, that a greater length of time will be required to investigate thoroughly the problems connected with the computation of alternating-current commutator motors.

B. G. Lamme described a variable-speed motor he had developed to drive print rolls. The principal objection to this machine was that it was limited practically to twenty-five cycles, if built in any considerable size. Sixty cycles would make a rather poor machine.

President Dunn said that it is easy to see the enormous part played by the advent of the commutator motor in all questions relating to variable speeds, and that advent is unquestionably due to the development of the single-phase commutator motor first for purposes of railroad work.

C. P. Steinmetz declared that, while the alternating-current motor has the reputation of being a constant-speed motor, in recent years a very large amount of work has been done in developing not only one but quite a number of types of variable-speed alternating-current motors. While considerable advance has been made, there is no doubt there are still many further developments possible and desirable, because there is one feature which impresses itself very forcibly upon us, and that is that in most of these variable-speed motors, the variable speed is connected with the use of the commutator. We know from the direct-current motor that a commutator motor can be extremely successful, but, on the other hand, it has always been claimed and stated that the great advantage of the alternating-current motor is its great simplicity due to the absence of any commutator or similar device. The standardization rules divide motors into two types: constant-speed and variable-speed motors. Of the latter, three classes are distinguished: multispeed motors, those motors which have several steps of constant speed and which can by adjustment be operated not only at one but at two or more speeds; second, varying-speed motors, those motors in which the speed varies with the load, as a rule decreasing with increase of load; third, adjustable-speed motors, those motors in which the speed can be adjusted to any desired value within a certain range, but which when once adjusted remain at this speed irrespective of the load, or approximately so. Now, alternating-current motors of these three types can be produced as follows. Multispeed motors can be built and are in industrial use to a considerable extent as induction motors without commutators—either by changing the number of poles by some switch-over device, or by concatenation of two motors, or by a combination of several of these methods whereby we can then gain a considerable number of speed steps. The varying-speed motor also exists as a motor without commutator. It is the induction motor with slip rings and external rheostat. In this motor with increasing load the speed decreases. It has the characteristic in its speed-torque relation similar to that of the direct-current series motor, except that the speed is limited to a definite maximum or synchronous speed. The limiting feature of this motor is that when the speed falls off the efficiency also falls off. The varying-speed motor, which is free from this dropping off of efficiency with dropping off of speed, is the commutator motor of the series type, or of the repulsion type, or the combined series-repulsion type. The adjustable-speed

motor, a motor which can run at any constant speed, does not yet exist of the alternating type without commutator, but it does exist in an almost infinite variety of commutator types of motors. However, such a motor free from the commutator would be the most useful, because very often in the industry we desire to be able to vary the motor speed over moderate range, as in cotton mills to adjust the speed to the materials and the atmospheric conditions and so as to operate the mill at the maximum efficiency point, which means the ability of varying the speed, say, twenty per cent, and still at any speed have constancy of speed independent of the load. That field for the alternating-current motor is still open for development.

C. O. Mailloux said he remembered well when the commutator was charged with all the crimes in the calendar, and it was considered a great objection in connection with electrical machinery in general. It was therefore interesting to note at the recent Turin congress, the manifestation of the return to a spirit of greater toleration. The electrical engineers at that congress were not disposed to criticise the commutator, as had been the wont of the alternating-current advocates, for the reason that in Europe at the present time electric traction has taken a new turn and the single-phase system is in vogue, and this involves the commutator motor. That in itself was sufficient to change the opinion of a great many men who some years ago would have thought a commutator motor was not fit to use for traction purposes at all. When we come to study speed regulation, even with the familiar three-phase motor, we are obliged to come to the commutator. The commutator motor, even before the advent of the interpole motor, was giving a very good account of itself. Today with the auxiliary commutating pole, we may say we are getting absolutely satisfactory, if not absolutely faultless commutation. The problem is not as simple, however, with alternating-current commutator motors; there are many difficulties due to reactions and magnetic phenomena which are not taking place in phase with each other, and it is necessary to use compensating devices to give a line of commutation which will not shift. Mr. La Tour has brought out a new line of variable-speed motors which are of great interest. He is able to get a range of speed from as low as one-tenth full speed up to full speed, with perfect commutation and very satisfactory efficiency and power-factor.

Mr. Maier then closed the discussion of his paper. The commutator seems to be more of a bugbear than it really is. Moreover, there seems to be no way of getting away from it at the present time. The Europeans have done a large amount of work on the commutator motor and use it in many places; the commutation is thoroughly good. There is one point which should be noted. The voltage on the commutator motor is very low compared to the line potential; it will probably run in the neighborhood of from 50 to 100 volts. Then with some sparking on the commutator, if the commutator becomes black, it does not seem to affect the commutation or operation of the motor in any way. The Europeans are running these motors in various places, for cotton mills, hoisting outfits, lathes, rolling mills, etc., and are getting very good results.

The meeting then adjourned and was followed directly by the first and very successful after-meeting smoker.

MEETING OF THE BOARD OF DIRECTORS.

The regular monthly meeting of the Board of Directors was held on Friday afternoon.

Upon recommendation of the Meetings and Papers Committee, it was decided that the annual convention be held in Boston during the latter part of June, 1912, the exact dates to be determined by the Meetings and Papers Committee.

The Committee also recommended a meeting of the High-Tension Transmission Committee in New York on March 8, a railway meeting in New York on April 5, and an industrial power meeting in Pittsburgh under the auspices of the Pittsburgh Section on April 25, 26 and 27, 1911.

At the November meeting of the Board an appropriation of $50 per meeting was authorized to defray the social expenses of the New York smokers, which are to be held each month after the reading and discussion of the paper of the evening. It was considered that this appropriation might set a precedent for the paying of social expenses from Institute funds, and resolutions were therefore adopted rescinding the action of November 10.

The amendment to the constitution providing for the election of the secretary of the Institute by the Board, which failed last year, was again discussed. The Board decided to resubmit this amendment to the membership.

The president brought up the modification in the method of making nominations which he had presented to the meeting of section officers at the Chicago convention, which had been formulated by Secretary Hutchinson. The arrangement is enacted by a new by-law in place of Section 18 of the present by-laws and is as follows:

Section 18. In addition to the names of the incumbent of office, the secretary shall publish on the "form showing offices to be filled at the ensuing annual election in May" provided for in Article VI, Section 30, of the Constitution, the names, as candidates for nomination, of such members and associates of the Institute as have been proposed for nomination for a particular office by the petition or by the separate endorsement of not less than fifty members or associates received by the secretary of the Institute in writing by January 25 of each year.

The names of such candidates for nomination shall be grouped alphabetically under the name of the office for which each is proposed and this by-law shall be reprinted prominently in the January issue of each year's *Proceedings*, and shall be reproduced on the form above referred to.

The Institute expressed its thanks to Mrs. Sidney Short for the bronze bust of Sidney Short.

The chairman of the Intermediate Grade of Membership Committee presented amendments to the constitution providing for an additional grade of membership in the Institute. The features of the plan are to make three grades of membership, arranging that the highest grade shall be slightly higher than the present grade of member, and that practically all the present members shall be automatically transferred thereto. The intermediate grade shall be somewhat lower than the present grade of member, and such of the associates shall be automatically transferred thereto whose records on file justify this. The vote of such associates as shall be transferred, and of such members as are in the highest grade, shall have an increased weight, the status of those who remain associates to be exactly as at present. The names suggested for the three grades are "Fellow," "Member" and "Associate."

The Board of Directors will consider the amendments for final adoption at its next meeting, the committee in the meantime being authorized to make recommendations for modifications in detail.

Central-Station Practice

DETERIORATION AND SPONTANEOUS HEATING OF COAL IN STORAGE.[1]

BY HORACE PORTER AND F. K. OVITZ.

Not many years ago, coal was commonly regarded as an extremely unstable material, subject to very serious alteration and losses on exposure to the elements. E. C. Pechin, in 1872, speaking before the American Institute of Mining Engineers, says: "Fuel suffers materially by * * * storage; especially with bituminous and semi-bituminous coals is the loss heavy, an exposure of only two weeks causing a loss of carbon to the extent of 10 to 25 per cent." Similar views have been held in much more recent times. For example, in a paper before the United States Naval Institute in 1906 we find the statement: "The pressure of the weight of coal causes gases to be evolved; * * * these gases constitute the chief and only value of the coal in that they furnish the heat units. It is claimed that if a ton of fine bituminous coal be spread out on a concrete pavement * * * in the open air in this climate (Key West, Fla.) for one year, it will lose all its calorific properties. The gases are simply free to escape, and when the coal has lost all its gas it will have lost all its heat units and be simply coke." This was only five years ago.

In 1907 a German gas-works engineer claims to have found that moist fine coal sustained an average loss per week of 1.7 per cent, this loss being due to gas. The 1889 edition of Groves & Thorp's "Chemical Technology of Fuels" says: "In some places coal is known to lose 50 per cent of its heating value in six months." Other statements like these are to be found in recent literature, but probably the great majority of chemists and engineers today hold no such exaggerated ideas on the subject. There is, on the other hand, a well defined suspicion, in the minds of many, that sufficient loss of volatile matter and sufficient deterioration by oxidation does occur in coal to be of industrial importance; and for that reason the investigations described in this paper were undertaken by the Bureau of Mines to determine accurately the extent of the deterioration in different types of coal.

First, a study was made in the laboratory of the loss of volatile matter from crushed coal during storage. A number of samples (twenty pounds each) representing a variety of types from widely separated fields, were broken to about one-half inch size and immediately placed in glass bottles in the mine. At the laboratory the accumulated gas was withdrawn and a free continuous escape of the volatile products permitted at atmospheric pressure and temperature. The results of these experiments have been published in Technical Paper No. 2, Bureau of Mines, entitled, "The Escape of Gas from Coal," and will therefore not be given here in detail. Suffice it to say that while several coals evolve methane in large volumes, especially in the early period after mining, the coal suffered in one year a loss in calorific value from this cause of but 0.16 per cent, as a maximum.

It seems therefore that the loss due to escape of volatile matter from coal has been greatly overestimated.

At the instance of the Navy Department, however, which is a purchaser of coal to the extent of two or three million dollars annually, and stores large lots in warm climates for long periods of time, more elaborate tests were undertaken to determine the total loss possible in high-grade coal by weathering. The extent of the saving to be accomplished by water submergence as compared to open-air storage was a point to be settled, and there had also arisen the question as to whether salt water possessed any peculiar advantage over fresh water for this purpose. An English railway and dock superintendent in an article in the London *Engineer*, 1903, reports that he has found coal accidentally submerged for ten years in the salt mud of the English Channel, actually improved in calorific value by 1.8 per cent, "which offers a very pretty question to chemists to say why." He claims that salt will preserve the virtues of coal as it does those of many other things: "If coal is given a strong dose of coarse salt and water, twelve hours before using, its calorific value is greatly improved."

Coal-storage problems have assumed importance during the last few years on account of the uncertainties of supply due to strikes and transportation difficulties. The naval coaling stations, the Panama Railroad Company, the Great Lakes commercial coal-distributing companies, large coke and gas or power plants at a distance from the coal fields and the railraods themselves, particularly those in the West, keep 50,000 to 500,000 tons in storage a great deal of the time.

In brief outline the tests by the Bureau of Mines were carried out as follows: Four kinds of coal were chosen: New River on account of its large use by the Navy, Pochahontas as a widely used steaming and coking coal in the eastern section, and as being also the principal fuel used in the Panama Canal work, Pittsburgh coal as a type of rich coking and gas coal, and Sheridan (Wyo.) sub-bituminous or "black lignite"—a type much used in the West. With the New River coal, fifty-pound portions were made up out of one large lot, which had been crushed to one-half inch size and well mixed. These portions confined in perforated wooden boxes were submerged under sea water at three Navy Yards, differing widely from each other in climatic conditions, and 300-pound portions from the same original lot were exposed to the open air, both out of doors and indoors, at the same places.

With the Pocahontas coal, test was made only at one point, the Isthmus of Panama, run-of-mine coal being placed in a 120-ton pile, exposed to the weather. Pittsburgh coal was stored as run-of-mine in open outdoor bins, five tons' capacity, at Ann Arbor, Mich., also in 300-pound barrels submerged

[1] Paper presented at a joint meeting of the New York Section, American Chemical Society, American Electrochemical Society, and the Society of Chemical Industry, November 10, 1911.

under fresh water. The Wyoming subbituminous was stored at Sheridan, both as run-of-mine and slack in outdoor bins, holding three to six tons each.

Every test portion was sampled each time in duplicate and in all cases except the outdoor pile at Panama and the 300-pound open-air piles of New River coal, the sampling was done by rehandling the entire amount. In the excepted cases mentioned it was not thought fair to disturb the entire lot, and therefore at Panama a vertical section of ten tons only was removed each time (eight samples being taken from the ten-ton section), while in the case of the outdoor lots at the Navy Yards a number of small portions, well distributed, were taken from each pile, mixed, and quartered down.

Small lots and a fine state of division were conditions purposely adopted with the New River coal so as to make the tests of maximum severity.

Moisture, ash, sulphur and calorific-value determinations, were made on each sample, the latter by means of the Mahler bomb calorimeter and a carefully calibrated Beckman thermometer. The calorimetric work on all except the Sheridan tests has been done throughout by one man, Mr. Ovitz, and with the same instrument. All the calorific values in the tables have been calculated to a comparable unit basis, *viz.*, that of the actual coal substance free of moisture, sulphur, and corrected ash.

The results show in the case of the New River coal less than one per cent loss of calorific value in one year by weathering in the open. There was practically no loss at all in the submerged samples and fresh water seemed to "preserve the virtues" of the coal as well as salt. There was almost no slacking of lump in the run-of-mine samples, and the crushed coal in all cases deteriorated more rapidly than run-of-mine.

The Pocahontas run-of-mine in a 120-ton pile on the Isthmus of Panama lost during one year's outdoor weathering less than 0.4 per cent in heating value and suffered little or no physical deterioration of lumps.

The Pittsburgh gas coal during six months of outdoor exposure suffered no loss whatever of calorific value, measurable by the calorimetric method used, not even in the upper surface layer of the bins.

The Wyoming coal lost as much as 5.3 per cent in one of the bins during two and three-quarter years, and 3.5 per cent even in the first three months. There was bad slacking and crumbling of the lumps on the surface of the piles, but where the surface was fully exposed to the weather this slacking did not penetrate more than 12 to 18 inches in the 2.75-year period.

No outdoor weathering tests have been made by the Bureau on coal of the Illinois type. Thorough tests, however, on this type have been reported by S. W. Parr, of the University of Illinois and B. A. Bement, of Chicago, both of whom find from 1.0 to 3.0 per cent calorific loss in a year by weathering. Mr. Bement reports a slacking of lumps (in tests on small samples) of over 80 per cent in one case and about 12 per cent in another. It is probable that in this type, as in the Wyoming, the slacking in a large pile would not penetrate far from the surface.

Storage under water unquestionably preserves the heating value and the physical strength of coal. But it practically necessitates firing wet coal, and therefore means the evaporating in the furnace of an amount of moisture varying from one to fifteen per cent, according to the kind of coal. This factor is an important drawback to underwater storage with coals like the Illinois and Wyoming types, which mechanically retain 5 to 15 per cent of water after draining, but in case of the high-grade eastern coals, if firemen are permitted, as is ordinarily the case, to wet down their coal before firing, "so as to make," as they say, "a hotter fire," then the addition during storage of the two or three per cent moisture which these coals retain would be of little consequence. Submergence storage is an absolute preventative of spontaneous combustion, and on that account alone its use may be justified with some coals, but merely for the sake of the saving to be secured by avoidance of weathering there does not seem to be good ground for its use.

SPONTANEOUS COMBUSTION.

Losses in coal due to spontaneous heating are a much more serious matter. Oxidation, probably in the main an absorption of oxygen by the unsaturated chemical compounds in the coal substance, begins at ordinary temperature in any coal, attacking the surfaces of the particles, thus slowly developing heat. In a small mass of coal this slowly developed heat can readily dissipate itself by radiation and no rise in temperature results. If radiation is restricted, however, as in a large pile densely packed, the temperature slowly rises. Now, the curve of oxidation rate plotted against temperature rises with great rapidity, and when the storage conditions are such as to allow a certain point (near 100 degrees centigrade) to be passed, the rate of oxidation is great enough ordinarily so that the heat developed overbalances the heat radiated and the temperature will rise to the ignition point if the air supply is adequate. The importance therefore can be seen of guarding against even moderate heating in the coal either from internal spontaneous causes or by radiation from external sources. Increased loss of heating value and of volatile matter occurs at moderately increased temperatures even though the ignition point is not reached.

The amount of surface exposed to oxidation in a given mass depends on the size of the particles and increases very rapidly as the fineness approaches that of dust. Dust is therefore a dangerous thing in a coal pile, particularly if it is mixed with larger-sized coal which forms air passages to the interior. Spontaneous combustion is brought about by slow oxidation in an air supply sufficient to support the oxidation, but insufficient to carry away all the heat formed. There is a wide variation among coals in friability. In comparative rattler tests under certain standard conditions, Pocahontas, New River and Cambria County (Pa.) coals produced nearly twice as much (through one-eighth inch screen) as a sample from the Pittsburgh seam. This is a large factor in spontaneous combustion. Mixed lump and fine, *i. e.*, run-of-mine, with a large percentage of dust, and piled so as to admit to the interior a limited supply of air, make ideal conditions for spontaneous heating.

High volatile matter does not of itself increase the liability to spontaneous heating. A recent circular letter of inquiry on spontaneous combustion sent by the Bureau to more than 2,000 large coal consumers of the United States has brought 1,200 replies, of which 260 report instances of spontaneous combustion, 220 of them naming the coal. Of these 220, 95 are in semi-bituminous low-volatile coals of

the Appalachian region, and 55 in western and middle western coals. This result shows at least no falling behind on the part of the "smokeless" type, and no cause for placing special confidence in these coals for safety in storage.

A serious fire in cinder filling under a manufacturing plant in Pittsburgh was recently investigated by the Bureau and all the evidence pointed to spontaneous combustion as the cause, induced by external heat radiated from a furnace. The cinders contained forty per cent of carbon. A similar fire occurred two years ago in cinder filling under a smelting plant on Staten Island, in which case the cinders contained thirty-three per cent of carbon. Damage amounting to $20,000 was done. The cause was not definitely determined, but from the reports of the insurance adjusters, spontaneous heating appears to be the most plausible explanation. The volatile matter in the material could not have been a factor in these causes.

Pocahontas coal gives a great deal of trouble with spontaneous fires in the large storage piles at Panama. It is reported also by several large by-product-coke concerns to be more troublesome in this respect than their high-volatile-gas coals. The high-volatile coals of the west are, to be sure, usually very liable to spontaneous heating, but they owe this property to chemical nature of the substances which compose the coal rather than to the amount of volatile matter. Strange as it may seem, a high-oxygen content in coal appears to parallel its avidity for oxygen and to promote therefore its tendency to spontaneous combustion.

The influence of moisture and that of sulphur upon spontaneous heating of coal are mooted questions much discussed, not very much actually investigated, and certainly not yet settled. Richters has shown that, in the laboratory, dry coal oxidizes more rapidly than moist, but the weight of opinion among practical users of coal is that moisture promotes spontaneous heating. The observation by the Bureau of many actual cases has not developed any instances where moisture could be proven to have had such an effect. Sulphur, on the other hand, has been shown by these investigations to have, in most cases, only a minor influence. In a number of actual cases, samples of the heated coal from areas where the heat was greatest have been analyzed, both for the total sulphur and that in the sulphate form. The difference between these, or in other words, the unoxidized sulphur, was in no case less than seventy-five per cent of the average total sulphur in the original. In other words, not more than one-fourth of the total sulphur has entered into any heat-producing reaction. The possibility remains, however, that all of the sulphur which was oxidized was concentrated in one pocket of moist flaky pyrites, and thus sufficient heat was developed in one spot to act as an igniter. On the other hand, a Boston company, using Dominion (Nova Scotia) coal of 3 to 4 per cent sulphur, has much trouble with spontaneous fires in storage, but a number of samples taken by the Bureau from exposed piles of this coal in which heating had occurred showed that 90 per cent of the suphur was still unoxidized. Experiments in the laboratory, passing air over coal at 120 degrees centigrade, have developed enough heat to ignite the coal and no change was found in the form of the sulphur. While not entirely conclusive, these results point to a very minor contribution, if any, on the part of sulphur to spontaneous heating in coal.

Freshly mined coal and even fresh surfaces exposed by crushing lump coal exhibit a remarkable avidity for oxygen, but after a time become coated with oxidized material, "seasoned," as it were, so that the action of the air becomes much less vigorous. It is found in practice that if coal which has been stored for six weeks or two months and has even become already somewhat heated, be rehandled and thoroughly cooled by the air, spontaneous heating rarely begins again. A large power plant in New York crushes its coal to pass a four-inch screen immediately after unloading from barges, the fines and dust, fifty per cent or more, being left in the coal to be stored. This freshly crushed coal is elevated to iron hopper-shaped bunkers directly over the boilers and the air temperature in these often reaches 100 degrees Fahrenheit. As the coal hangs on the sloping sides sometimes three or four months at a time, it seems hardly surprising that some of the bunkers are on fire practically all of the time.

With full appreciation of the fact that any or all of the following recommendations may under certain conditions be found impracticable, they are offered as being advisable precautions for safety in storing coal whenever their use does not involve an unreasonable expense.

(1) Do not pile over 12 feet deep nor so that any point in the interior will be over 10 feet from an air-cooled surface.

(2) If possible, store only lump.

(3) Keep dust out as much as possible; therefore reduce handling to a minimum.

(4) Pile so that lump and fine are distributed as evenly as possible; not, as is often done, allowing lumps to roll down from a peak and form air passages at the bottom.

(5) Rehandle and screen after two months.

(6) Keep away external sources of heat even though moderate in degree.

(7) Allow six weeks' "seasoning" after mining before storing.

(8) Avoid alternate wetting and drying.

(9) Avoid admission of air to interior of pile through interstices around foreign objects such as timbers or irregular brick work; also through porous bottoms such as coarse cinders.

(10) Do not try to ventilate by pipes as more harm is often done than good.

Spontaneous Ignition of Coal.

At a recent meeting of the Manchester District Institution of Gas Engineers, E. A. Harman said that one of the troubles connected with the storage of coal is its liability to take fire spontaneously or otherwise. There was great variety of opinion as to the cause of this heating. While it used to be suggested that the best method of preventing coal fires was to provide ample ventilation in the body of the coal and to keep it dry, recent investigation had proved this to be a fallacy. It was difficult, if not altogether impossible, in a large coal stack to properly ventilate it so that air circulated in sufficient quantity to carry away the heat generated by oxidation; and, therefore, if the heat was not removed, the admission of limited quantities of oxygen necessarily augmented the trouble. Although, as stated, at one time ventilation was freely advocated, in the author's opinion, it was disastrous. The tubes provided for ventilation or for taking temperatures formed an efficient primary air supply, with the result that when heating took place a large area might quickly be involved. The author had in his recollection definite

cases of fires being stimulated by a ventilation system, though, even in this matter, differences of opinion existed. When a coal stack was found to be heating, it was most undesirable to permit any disturbance by inserting rods to locate the body of the fire. Any undue heating of the coal soon made itself apparent. A rise in the temperature of the store was noticed, and the coal began to "steam," which was especially apparent on frosty days. As the heating proceeded some of the coal was distilled, and a brown oily deposit would be noticed wherever the resulting vapors made their escape. When this state of things was noticed immediate action must be taken, or the coal would soon burst into violent combustion.

In a report to the New South Wales Government, in the year 1901, on the spontaneous ignition of coal in bulk, the Royal Commission appointed to inquire into the cause of coal fires on board ships stated that the two conditions which brought about the spontaneous combustion of coal were (1) a sufficient supply of oxygen, and (2) a sufficient confinement of the heat developed by oxidation. Also that the most favorable conditions for heating occur in heaps of moderately lumpy coal mixed with certain quantities of coal dust. The commission also found that coal stored in hot weather was more liable to combustion than that stored in cold weather, and that the danger increased with the thickness of the heap.

In some experiments conducted to ascertain the effect of water, two similar cubical bins were filled with about 245 tons of coal. Every precaution was taken to keep the coal in one of them dry, while that in the other was saturated with water. In the course of seventy-three days the temperature of the dry coal (at the center of the bin) had risen sufficiently to melt the soldered connections of the thermometer, while the wet coal showed no signs of heating after five months. They therefore recommended that when the atmospheric temperature rose to over 90 degrees Fahrenheit, the coal to be stored should be well wetted. It had been found that so long as the coal was not stacked to more than a certain height there was little danger of heating; but immediately this critical height was exceeded trouble was experienced.

With ordinary coals this height was from 15 to 20 feet. Where coal was to be stored in the open, it was therefore undesirable to stack it to a height of more than about 16 feet. When, however, it was necessary, owing to lack of ground space, to store coal to a much greater height than this, floors should be interposed, and adequate provision made for dealing with heated coal.

Apart from the suggestion so often advanced that spontaneous combustion may be the cause of coal heating and firing, the author had an experience not long ago of a coal stack firing by reason of a small portion of it having been unwittingly placed over a steam-pipe track which was laid in a channel covered by huge flag-stones. The fact that the surface was warm undoubtedly caused the fire to commence at that particular point.—*Mechanical Engineer.*

Commercial Practice—Management, Rates, New Business.

Service Pensions Adopted in Baltimore.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., has made the following statement with reference to the pension plan adopted at a meeting of the board of directors, held December 6, 1911.

At a meeting of the board of directors held a few months ago, upon the suggestion of President J. E. Aldred, a committee of the board was designated to inquire into and formulate a system of pensions for the purpose of making provision for the employees of the company who, after long years of faithful service, had reached an age when they were unequal to the further performance of their duties. The plan which was adopted makes provision for the following employees:

(1) Any employee who attains the age of sixty-five years after fifteen years of continuous service.

(2) Any employee who after twenty years of continuous service, is by reason of permanent physical or mental disability, unable to follow his usual employment in the company's service.

(3) Any employee after ten years of continuous service who shall become incapable of continuing in service by reason of injuries received while at work in the employment of the company.

The detailed plan for the application of the pension principle to the classes above mentioned is such as to result in very liberal treatment of the company's employees. It is provided that the entire cost of the pension system shall be borne by the company. The system calls for no contributions from the employees themselves.

Before adopting the plan outlined, a comprehensive survey was made of pension plans of public-service companies in this country and Europe. Endeavor was made to provide a broad, liberal and equitable plan, one which gives substantial recognition to long and faithful service to the company and the public.

The company believes that by thus voluntarily establishing a system under which continued income will be assured to those who, after years of continuous service, are, by age or infirmity, no longer fitted to perform their duty, will be accepted as an expression of appreciation of faithful and efficient service in the past and as an incentive for renewed effort to make the services rendered the public still more efficient and valuable.

The system, the company hopes, will increase among its organization a feeling of permanency in their employment and an enlarged interest in the welfare of the company and the community which it serves, and a desire to remain in and devote their best efforts to the services rendered the public.

The pension plan goes into effect on January 1, 1912, and affects all of the company's employees, numbering about 1,600.

Welfare Work of the Brooklyn Edison Company.

The Edison Electric Illuminating Company of Brooklyn has published a booklet containing an outline of the profit-sharing, service, annuity and investment-fund plan of that company for its employes. This same outline is placed in the first pay envelope of each new employe so that he may be fully informed of existing conditions when he takes up his new work.

There are also lists of employees' organizations and other matter of interest to those for whom the booklet is intended.

Advertising for Industrial Business.

The New Orleans Railway & Light Company is conducting an advertising campaign in northern cities urging manufacturers to locate in New Orleans. In Chicago a quarter page advertisement was run in the newspapers. The following was the text of one of the advertisements:

"Locate your new manufacturing plant in New Orleans, the leading city of the great Southland. The large packing houses of the country are investing millions in plants preparing for world-wide business.

"Extend your business. Increase your profits by locating an electrically operated plant in New Orleans and secure your electric supply from us. Be ready to supply the rapidly developing surrounding territory. Be prepared to serve the extension of trade through the Panama Canal.

"We furnish reliable and economical service to hotels, apartment houses, private residences and to industrial manufactories, which have saved first cost of installing plants by availing themselves of our reliable service."

Central-Station Co-operation With Contractors Shown in N. E. L. A. Policy.

An editorial in the current issue of the *Bulletin* of the National Electric Light Association clearly shows the enlightened attitude now prevailing between the central-station industry and the contractor.

"Recent changes in the constitution of the Association have recognized quite specifically the close ties existing between the central-station company and the contractor, and have made it easy for the latter to come into active fellowship and membership with all its privileges and benefits shared in common with those who are actually in central-station service and employ. Our industry is under infinite obligations to the contractor; upon his good work and efficiency must always depend the measure of success with which the public can be supplied with electricity in its varied forms and applications. It is thus of the utmost concern to all that the relations with this important element in the business should be friendly, cordial and harmonious. In days when the central station dealt with comparatively few customers, and, so to speak, met each of them personally before the service was installed or connected, the significant place of the contractor in the art was far from being understood. Now, when frequently every new house or building in a city takes electric service, and when, in some cities, there is a meter to every ten or even five of the population, conditions have changed radically in giving the contractor his proper recognition as an extremely important factor in the art and its prosperity. The suggestion was recently made that the *Bulletin* could be useful in advancing this point of view, and it now does so with great pleasure, inviting the suggestions and co-operative effort of its readers in this policy of 'getting together.'"

Educational Advertising Displays.

The *New York Telephone Review* devotes considerable space to an article discussing methods by which advertising displays in windows, at fairs, expositions, etc., may be made more effective.

Window dressing has reached the point where it is now even being taught by many correspondence schools.

To be effective any advertising must accomplish two things. First, it must attract the attention of the reader or beholder, and secondly, it must convince him that he needs the goods advertised. Newspapers are in a class by themselves; pamphlets and novelties are good means of securing additional publicity. When these can be supplemented by actual displays of the goods themselves, however, their value is greatly enhanced.

As examples of this last method, it describes several successful telephone exhibits which not only displayed the apparatus used, but graphically illustrated the various kinds of telephone service which the New York Telephone Company furnishes.

Ft. Worth Company Secures City Pumping Contract.

The Fort Worth (Tex.) Power and Light Company recently obtained a contract with the city of Fort Worth for furnishing electric power for the city's new water-pumping plant and for all other of the municipal pumping stations. It is estimated that it will require about 1,500 horsepower to operate all the city's wells, and that when all the wells are electrically equipped the gross earnings of the company will amount to $150,000 annually.

How the Rochester Company Uses Electric Signs.

For some time the Rochester Railway & Light Company, Rochester, N. Y., has had in use four changeable electric signs to advertise its business. Two of these signs are located near the center of the city, one being along a railroad and one across the front of the company's offices. The other two are in conspicuous locations, where they attract considerable attention and interest.

All are changeable, using skeleton letters upon angle-iron frames. On two of the signs four-foot letters are used, and with a stock of seventy-five letters the company is enabled to make six different slogans, as, for instance: "Use Electric Signs," "Use Electric Trucks." On the other two signs thirty-inch letters are used, and, having a stock of 100 letters, the company is enabled to make eight changes, such as "Use Electric Power," "Cook With Gas," etc.

These signs have meant a great deal to the company, according to L. W. Layman of the commercial department. Not only have they produced business for the various services which they advertise, but they have also greatly stimulated interest in electric signs in Rochester. The company, also, often loans these signs to the city, Chamber of Commerce, or any movement for charity or the common good. By doing this not only is the company contributing its share to the success of any movement to which it is asked to give publicity, but at the same time public interest in these signs is intensified.

The success of these signs has been so marked that an additional sign is being built. This will be 30 by 50 feet, built on angle-iron frame, so spaced that letters of two feet, or multiples thereof, can be used. Around this sign will be a border of red and green lamps, either of which can be thrown on, or the border may be changed alternately every night or two. The current for this sign is alternating and transformers will be used so that twelve-volt Mazda lamps may be employed.

This new sign will also be rented to local merchants and manufacturers for periods not to exceed two months, thereby keeping it changeable and the public interested in the changes which are made from time to time.

Telephony · Telegraphy and Wireless

RATIONAL TELEPHONE RATES—II

BY FRANK F. FOWLE.

The question next arises as to what constitutes a unit of demand. Obviously this is a local call; and it is important to observe that one call, issuing from one subscriber's line, is a unit of fixed and indivisible nature. Then in order comes the question as to what comprises the maximum demand. Proceeding from the general practice of taking one hour as the shortest division of time used in compiling exchange load curves or load data, it would be logical to assume that the maximum demand is the maximum number of calls per hour, from any given line. There are some difficulties, however, in such a plan. In the first place, an hour is rather a long period on which to base the maximum calling rate; that is, the average rate for one hour might be considerably less than the fifteen-minute rate, for example. Again, an even hour by clock time, such as 10 a. m. to 11 a. m., might give results quite unlike some hour taken at random, such as 10:19 to 11:19 a. m. Futhermore there is no simple way to measure the maximum rate automatically, but a large number of observations must be taken periodically on lines of each class, by a process of supervision.

It would be possible of course to determine, by very extensive observations, the maximum hourly calling rate for subscribers' lines of each class, and distribute the demand costs (class II) on this basis. But it is a matter of some conjecture as to what degree of equity would thus be obtained. In the same way it would be possible to find the rate for a shorter period, but the question of how long a period to take is quite important. A long period obviously does not disclose the maximum rate which may exist during a very short period. If an operator handles 150 measured-service calls per hour, during the load peak, each individual call demands twenty-four seconds of her time, on the average. If the average duration of a message, from call to disconnect, is two minutes, an operator can dispose of five calls in a like interval; and if a subscriber made consecutive calls at the rate of thirty per hour, his demands would consume only one-fifth of the operator's attention. But so high a calling rate would not ordinarily be maintained for more than a small fraction of an hour, except under rare circumstances.

If the average duration of a message is two minutes, then it is apparent that at the end of any two-minute period all the connections which were up two minutes previously have since been taken down; this is not wholly true, in a strict sense, because some messages will cease in less than two minutes and some will continue longer. But it serves to illustrate the shifting character of the demand and how rapidly it arises and disappears. It is impossible to conceive the demand from any individual line as being continuous, except possibly on the trunking system. As a whole, however, the demand is intermittent and diversity of individual demands is present in a very great degree. The last fact is well illustrated by the very low probability that out of any ten subscribers, who make one call each in a common period of five minutes, several or all will call simultaneously; in fact, the probability is not great that any two will call simultaneously.

It is fairly obvious that the briefer the period selected in which to find the maximum calling rate or demand, the nearer will the average maximum approach the instantaneous maximum. Equally obvious is the fact that the instantaneous maximum is one call per line. On the latter basis the demand costs (class II) would be distributed in proportion to the number of lines in service for originating or outgoing calls. A line used exclusively for inward business would make no direct demand and hence would bear only a flat rental. Provisionally, at least, there are several arguments in favor of adopting one call per line as the maximum demand, not least of which is the extreme simplicity. Quite evidently one call per line is the lowest maximum that can exist in any case, and at the same time is the greatest instantaneous maximum. The most equitable demand basis cannot be finally settled until it is determined exactly what average maximum fixes the size and capacity of the common portion (class II) of the plant.

In this connection it is more than likely that a consideration of the matter on a readiness-to-serve basis would lead to a distribution of the class II costs on a basis of the number of lines, coinciding with the call-per-line demand theory. While the two methods might lead to common results up to this point, there are fundamental differences beyond, in the manner of working out the rate schedules.

Accepting the call-per-line demand basis, for purposes of illustration at least, the matter of selecting suitable plant and service units has been covered generally and the matter of rate schedules is in order. Specific figures have been adopted in what follows; they are not submitted as legitimate or equitable rates, but for the purpose of illustration solely, although an effort has been made to have them consistent and within reasonable limits. Let it be assumed that the foregoing analysis, in a specific instance, reveals unit costs as follows:

TABLE I—UNIT SERVICE COSTS.

Class I—	Annual station rental	$6.00
	Annual line rental	12.00
Class II—Annual demand charge		15.00
Class III—Traffic charge, per message		0.01

These unit costs would theoretically provide an annual revenue of $31.40 per station, assuming an average of 2.5 stations per line and 1,460 messages per annum, or four per day. The class I costs comprise the minimum charge for service and might be given any one of a variety of names, such as minimum bill, readiness-to-serve charge, or line and station rental. This portion of the cost of service is fixed, and independent of the amount of traffic to and from the station; it might be termed the flat portion of the rate. The actual charge for several classes of service would be as follows:

TABLE II—ANNUAL LINE AND STATION RENTALS.

	Per Annum.
Direct line	$18.00
Two-party line	12.00
Four-party line	9.00

These rates would cover the privilege of central-office connection without any originating or outgoing calls, but unlimited incoming calls. In this way the minimum rate for service, of any class, is brought down to its lowest profitable amount, because the traffic expense is eliminated. Hence this plan will result in lower minimum rates than can possibly be obtained with measured service as now generally applied; in the latter a minimum number of outgoing messages is almost invariably included in the base or minimum rate. For example, a measured rate has been stated thus: direct line, business telephone, $60 per annum, including 1,200 outgoing messages; additional messages at three cents each for the next 2,400 and at two cents each for all in excess thereof. Obviously the $60 rate could be made less if no outgoing messages were included. For this reason it is believed that the proposed system will stimulate telephone development in a greater degree than has yet been possible.

The combination of class II and class III costs to form a sliding scale of message charges is quite simple. The manner in which this would be worked out, employing the unit costs in table I, is shown in the next table, for the specific case of direct-line service.

TABLE III—UNIT MESSAGE RATES FOR DIRECT OR SINGLE LINES.

Messages per annum.	Message Charges. Demand Portion—Class II.	Traffic Portion—Class III.	Total.	Rate per message.
300	$15	$3	$18	$0.0600
600	15	6	21	.0350
900	15	9	24	.0267
1,200	15	12	27	.0225
1,500	15	15	30	.0200
1,800	15	18	33	.0183
2,100	15	21	36	.0171
2,400	15	24	39	.0162
3,000	15	30	45	.0150
3,600	15	36	51	.0142
4,200	15	42	57	.0136
4,800	15	48	63	.0131
6,000	15	60	75	.0125
7,200	15	72	87	.0121
8,400	15	84	99	.0118
9,600	15	96	111	.0116

This table shows clearly how the average message charge decreases as the use or volume of outgoing traffic increases, from approximately one call per day up to thirty per day. The average rate per message drops correspondingly from six cents to about one and one-sixth cents.

So far as party lines are concerned, it may be observed that as between such a line and a direct line, on which the number of originating calls per day are the same, there is no difference in the demands on the plant. It seems to follow from this that party-line stations should bear only their respective shares of the demand charge per line. Following up this principle, it develops that as a whole party-line subscribers would pay a lower message rate than direct-line subscribers. But party lines are intended for subscribers whose needs are limited and furthermore it is desirable that in some way a party-line subscriber would find it to his advantage to take a direct line when his needs correspond. There is nothing unreasonable in this, because a subscriber who uses a party line to excess interferes with and greatly impairs the service of others. Hence it is questionable whether the message charge should be graded for party lines; clearly it should not be graded to the extent shown in table III. And since party-line use is, or ought to be, limited, there may be no difficulty in working out a descending scale of message charges, of which only the high portion would apply to party lines, while the schedule as a whole would apply to direct lines. This principle goes further, of course, and applies equally to a subscriber who has one direct line, but needs two, or more; that is, there is a reasonable limit to the use of single lines consistent with good service.

Lack of space forbids a more elaborate discussion of these features and permits only of the presentation of the general principles underlying the proposed method of cost analysis and rate making. The system of charging just outlined is a combination, in fact, of flat and measured-rate principles as now used. Its advantages are believed to be two-fold: first, it approaches more nearly to absolute equity and fairness than either the flat-rate or the measured-service principle; and, second, it provides lower minimum charges for service of each class than either of the rate systems just mentioned. These advantages, if sustained by actual trial and comparison, should go far toward making telephone service even more useful than it is at present and should bring it within the reach of many small users who have not yet found themselves able to afford it.

In closing it is proper to state that the proposals advanced have been greatly condensed in order to bring them within the scope of this treatment and many refinements have necessarily been omitted. The best answer to arguments that flat or measured rates are more eqiutable, or fairer, is contained in the principles of analysis as presented. The application of these well known principles in public-service rate making to the case of a telephone system needs no apology or defense, though it may present many new ideas to telephone men who have accepted the existing telephone rate practices as the last word on the subject. The search for a rate system at once equitable and rational seems to point to an abandonment of both the existing systems, in part, and a combination of their elements in accord with broadly accepted theories of cost analysis.

A Wireless-Operated Boat.

There was recently exhibited on the Danube at Vienna, Austria, a boat which is controlled by wireless energy from the bank, without any person being on board. This boat is described as being constructed on the system of Wirth, Beck & Knauss, of Nuremberg, Germany. It has attracted many spectators—military, scientific, and the simply curious—who pay a small sum for admission to the immediate vicinity of the operator on the bank. The boat carries a storage battery which furnishes its motive power, the "system" or invention consisting in the adaptation of wireless electric waves of different lengths to the control of the motive power, steering gear, and other mechanism. This system, it is also claimed, will prevent disturbance by electric waves elsewhere generated within the same sphere of influence.

At a recent exhibition the boat was manifestly operated without other control than that exercised by the manipulator of the wireless mechanism on the bank. It moved forward and back, turned right and left, described figures, was guided to definite points, rang bells, exhibited flags and lights, fired guns, etc., giving proof of effective control. The mechanism is, however, far from perfect; the speed is not great, the responses to the operator's will are hesitating and inexact, and the range is limited to about a hundred yards.

English Authorities Trying Automatic Telephones.

The British Post Office authorities, who are about to take over all the telephones in the United Kingdom, have recently made a number of demonstration tests of automatic telephone equipment, with the possibilities of which they were much impressed.

Industrial Power

RELATIVE ADVANTAGES OF GROUP AND INDIVIDUAL DRIVE AND THE COST OF INDUSTRIAL ELECTRIC POWER.[1]

BY C. W. DRAKE.

Motor drive is not as some people are inclined to believe, a panacea for all industrial ailments, although there are but few plants in which motor drive properly applied will not improve conditions. Hence it may ordinarily be assumed that motors are to be installed, and the questions to be settled are: What type of drive to use, and whether to generate the power or to purchase it from a central station. It is not the purpose of this article to attempt to show how to lay out an electrical equipment for any special industry, but rather to call attention to some of the more important factors bearing on the type of drive to be used, and the power supply.

Motor drives are installed because they produce a greater profit in the industry, and not because they are the ruling fad. Increased profit may result from increased quantity, improved quality, reduced power consumption or a combination of these conditions. Consequently, before any action towards the installation of motors is taken, figures should be available showing what may be expected in the line of first cost, power consumption, maintenance, and improved manufacturing conditions from several systems of drives.

There are two general systems of drive; namely, group and individual, and the choice between these two for various applications is often a question of dispute. The power cost in most industries is less than five per cent of the total manufacturing costs, so that a slight increase in production will quickly offset a large saving in power and consequently the item of prime importance in laying out motor drives is production, and after all items bearing on it are taken care of, the question of power cost and type of drive may be considered. Each installation is a separate problem in which there are many factors and the degree in which one or more of these various factors predominate, determine the type of drive to be used.

Outside of factors bearing directly on production, other points to consider when comparing group and individual drive are:

(1.) Investment.
(2.) Rate for power.
(3.) Machine load and time factor.
(4.) Shafting friction.
(5.) Maintenance.

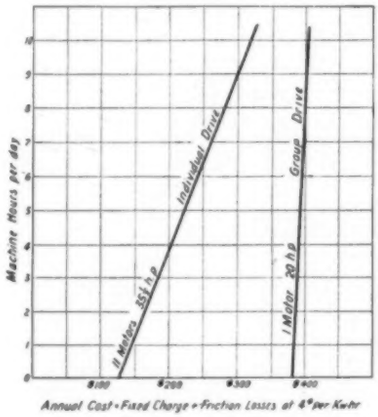


FIG. 1—RELATIVE ANNUAL COSTS.

Investment is one of the principal factors that prevent the installation of individual drives, since this figure can be quite accurately determined while the saving in energy is more or less approximate and problematical.

With individual motor drive the total horsepower rating of the motors installed in a plant will be considerably greater than with group drive, but the maximum power demand of the plant is approximately the same in either case. Some power contracts with central stations are based on the horsepower connected, or on the maximum demand considered as a certain percentage of the connected load. It is easily seen that a rate basis as above would tend to prevent the installation of individual drives since a group drive would obtain a lower basic rate, although the high efficiency of the individual drive would tend to reduce the actual power consumed. A more logical basis of charging for power would be on the actual maximum power demand which is either estimated or obtained by test, together with the actual energy consumed. On this basis the individual drive by reason of its lower transmission losses will show a lower power cost than the group drive.

In group drive there are two distinct loads, the variable load of the machines and the friction of the shafting and belting. The lower the machine load-factor, the greater becomes the percentage of the friction load and the more inefficient the transmission.

In order to show more clearly the relative advantages of individual and group drives, an example has been made of an existing planing mill. At present a twenty-horsepower 840-revolution-per-minute squirrel-cage induction motor is installed driving eleven machines by means of a sixty-foot shaft (eight hangers) and six two-hanger countershafts. The cost of the twenty-horsepower motor for group drive is assumed as $297, and cost of the shafting and hangers, in place, as $210.

If, on the other hand, the eleven machines were operated by individual motors, the following table shows the size and speed that would be recommended for each machine.

Machine	Motor H.P.	Motor R.P.M.
30-in. single surfacer	7½	1120
8-in. four-side moulder	7½	1120
16-in. hand-feed rip saw	5	1700
20-in. swing cut-off saw	3	1700
Single spindle shaper	3	1700
18-in. jointer	3	1700
Tenoner	3	1700
Mortiser	2	1700
Jig saw	½	1700
Drill	½	1700
Double emery wheel	½	1700

The cost of the eleven motors for individual drive is approximately $848.10. The fixed charge has been figured as fifteen per cent, which for this class of service should cover depreciation, interest, taxes and insurance.

It is assumed that with individual drive when the machines are not running the motors are shut down, while with group drive the belts are on loose pulleys. The proper motor losses have been added in each case. The friction loss in each bearing is figured as 100 watts and an idler pulley is consid-

1 Paper presented before the Engineers' Society of Western Pennsylvania.

ered as a bearing. The actual load on the machines has been assumed the same with both drives and consequently is neglected. For the plant in question the fixed and operating charges are lower for the individual drive, regardless of the machine hours per day, although for long hours of service the difference between the two drives becomes less. Practically all of the advantages from a production standpoint are with the individual drive so that there is very little excuse for using group drive in this case.

If all the machines worked six hours per day, or had a time-factor of sixty per cent, for all rates of one cent and above the advantage is in favor of the individual drive. For long hour service and very low rates the group drive has a lower total cost.

There is no sound reason for using group drive throughout in planing mills, and the example taken is entirely characteristic of this class of plants. The plant with group drive has a total of seventy-two feet of shafting, twenty hangers, eleven idlers and eighteen belts, while with individual drive there would be at the most eleven belts and no overhead hangers or belts. To any one familiar with shop maintenance it is not difficult to see on which side of the book the balance for maintenance will be.

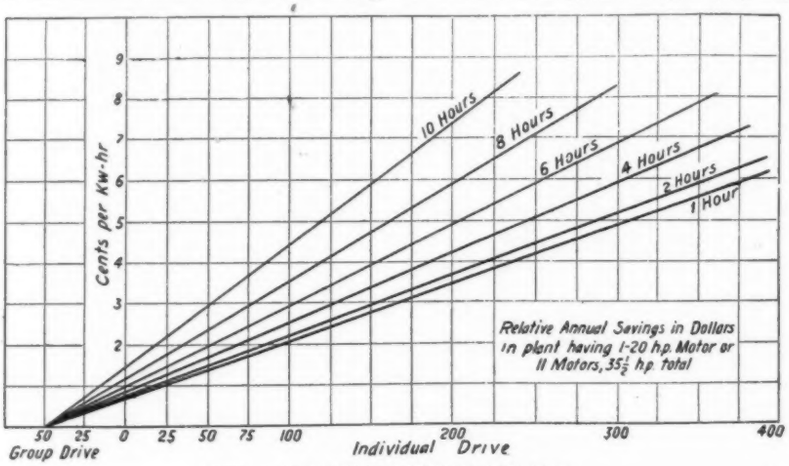

Cents per Kw-hr
10 Hours
8 Hours
6 Hours
4 Hours
2 Hours
1 Hour
Relative Annual Savings in Dollars in plant having 1-20 h.p. Motor or 11 Motors, 35½ h.p. total
50 25 0 25 50 75 100 200 300 400
Group Drive
Individual Drive

FIG. 2—RELATIVE ANNUAL SAVINGS.

Although a concrete example was taken in order to obtain definite figures for the curves the same reasoning might be applied to plants of any size or in any industry. In large plants both individual and group drives are often used, the choice depending on the nature of the work done in the machines, the number of hours use per day and other factors as previously mentioned. It should be always borne in mind that the question of production predominates but that the actual power saving in individual drive by eliminating shafting and belts is sufficient to pay much more than the fixed charges on the increased investment.

THE COST OF POWER.

This subject has been so thoroughly discussed and explained in recent periodicals (Cost of Industrial Power by Aldis E. Hibner and Comments on Fixed Costs in Industrial Power Plants by John C. Parker, Trans. A. I. E. E. March, 1911; Notes on Factory Power Costs by H. H. Holding, Electric Journal, June, 1911), that there is little new to add to the subject but at the same time it is of sufficient importance to warrant a review at this time. For the power supply for any industrial plant there are two possible sources; a private plant or a central station. In most cases there is no question regarding the reliability of the central-station power and the only factor tending to retard its use is the rate. Owners of private plants often declare that they can make power much cheaper than they can buy it from a central station. The reason for this statement is in most cases that the owner of the isolated plant really does not know what his power costs him. The central station exists solely to manufacture and distribute power and has an organization especially trained for that work. The owner of the isolated plant is in business to manufacture some commodity and the manufacture of power is entirely outside of his regular business. His time could be spent to much better advantage in the business for which he is specially trained and which is producing dividends for him. Why should he manufacture electric power any more than manufacture his own gas, or pump his water when all are available and delivered at his door, with service which is both reliable and economical?

The cost of power may be readily divided into two parts, one covering the fixed charges and the other the variable or operating expense. Many people are accustomed to consider the fixed charges as negligible or if they do consider them, to omit many of the important items. The private plant must be of sufficient capacity to supply the maximum demand, and the load-factor, or ratio of the average to the maximum demand, varies from five per cent in some planing mills to nearly 100 per cent in electrolytic work. Hence in most plants the generating equipment is working at a fractional load most of the time.

Looking further into the investment we find that the first cost of the plant should cover the cost of the land, buildings, prime movers and generators, boilers or gas producers, and auxiliaries such as pumps, piping, switchboard, cables, etc. The yearly charges against the investment are made up of depreciation, interest, taxes, insurance, rental value of ground, etc.

Large central stations with most improved machinery may be installed for $60 per kilowatt but for small industrial plants say of 100-kilowatt capacity the investment may reach $150 per kilowatt. Let us consider for example a 100-kilowatt steam-engine plant having an investment of $125 per kilowatt and a yearly charge of 17 per cent or $21.25 per kilowatt. This charge is made up of depreciation 8 per cent, interest 6 per cent, taxes, insurance, etc., 3 per cent. Some people are inclined to allow even greater than 6 per cent interest since the power plant is part of the factory and money invested there is expected to produce better than 6 per cent.

On the basis of 300 twenty-four hour days per year of full-load operation, the investment charge is 0.295 cents per kilowatt-hour. For ten hours of full-load operation the cost per kilowatt-hour due to investment is 0.708 cents. As previously stated very few plants operate at 100-per-cent load-factor so the above charge must be corrected for the existing load-factor.

In Fig. 4 the effect of plant load-factor on the investment charge is

shown and is based on full-load operation for ten hours per day. Since only one generating unit is considered in the present case the variation in load must be taken care of entirely by the governor so the coal consumption is shown as increasing with decreasing load-factor. A full-load efficiency of eight pounds of coal per kilowatt-hour is assumed and a rate of $1.50 per ton for coal, which is a fair average for Pittsburgh and vicinity. Another fuel curve based on coal at $3.00 per ton is also given together with a total cost curve under these conditions. From the two total cost curves it is seen that at 60-per-cent load-factor a reduction of 50 per cent in the price of coal reduces the total cost of power about 21 per cent.

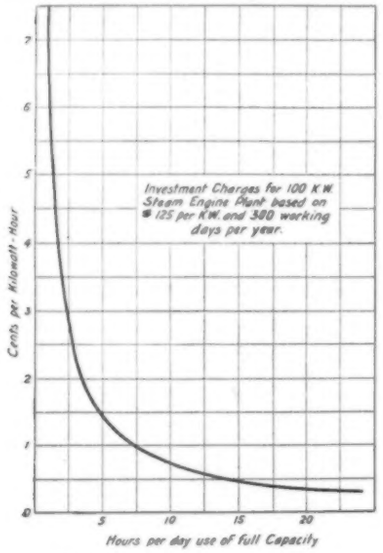


FIG. 3—INVESTMENT CHARGES.

It has been considered that an engineer with a salary of $75 per month could operate the plant and that the incidentals as oil, water, waste, etc., would average $20 per month.

On the above basis the four curves for fuel, investment, labor and incidentals have been plotted and total power cost is the summation of the four. With a load-factor of 100 per cent for ten hours the power cost (coal $1.50 per ton) is about 1.7 cents per kilowatt-hour, while for a 60-per-cent load-factor it is 2.6 cents per kilowatt-hour. Even in the above discussion many items have been omitted such as superintendence or the time that the $5,000 manager applies to power-house problems. The time and production lost due to breakdowns or late starts should also be charged but these are items that have to be obtained in each individual case.

From the above consideration the effect of decreased hours of full-load service together with the effect of load-factor on the cost of power are clearly shown so it should be fairly clear that the central station which operates twenty-four hours per day can produce power cheaper than a private plant operating ten hours per day. The question of load-factor affects the central station in just the same manner as private plants and in order to increase their load-factor central stations make very low rates for off-peak loads. This load can be carried without additional equipment and investment charges so it is to the advantage of the consumer to avail himself of the low power rates during these times and by so doing still further raise the load-factor on the central station and reduce the cost of power to all.

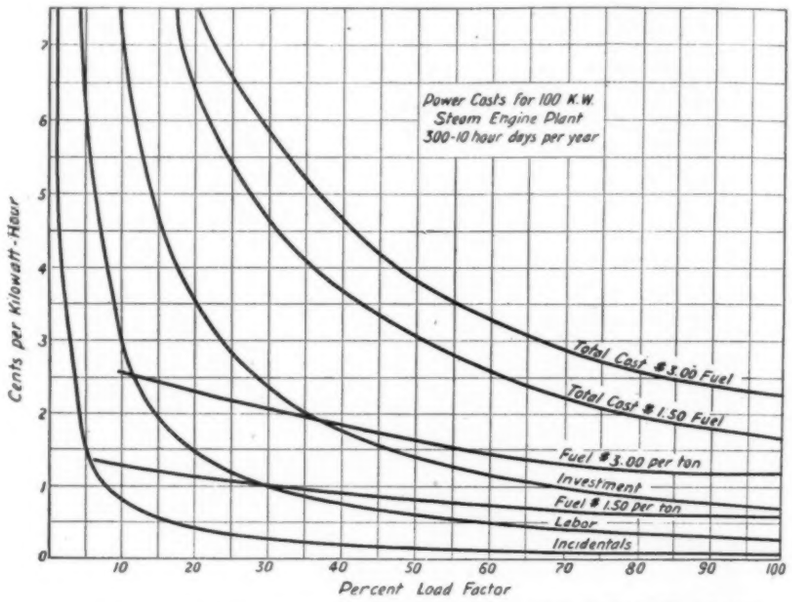


FIG. 4—POWER COST FOR 100-KILOWATT STEAM-ENGINE PLANT.

Electrolytic Production of Ozone.

The electrolytic production of ozone was recently investigated by E. H. Archibald and H. von Wartenberg. Dilute solutions of sulphuric acid were electrolyzed with direct current and with alternating current superimposed. Owing to the depolarizing effect of the alternating current, the output of ozone was greatly increased over that obtained with direct current alone. In some cases the increase was three hundred fold. Platinum electrodes were used. By keeping the intensity of the direct current constant and increasing the alternating current step by step the amount of ozone rose steadily. The maximum output was obtained at about six amperes, alternating current, for all values of direct current between 0.25 and 1.00 amperes. An increase in frequency was accompanied by an increase in the ozone output.—*Zeitschrift für Elecktrochemie.*

Electric Energy for Christiania.

A special committee appointed to consider the question of supplying Christiania with electricity has recently issued its report, and recommends the exploitation of the waterfalls belonging to the town, and the acceptance of an offer from the Vamma Power Company to supply, at a price agreed upon, 25,000 horsepower. The power-transmission installations proposed are to have a capacity of 56,000 horsepower, and at the expiration of the contract time they will pass into the possession of the town. The contract will expire in the year 1948.

It is estimated that the town's waterfalls in the River Glommen will yield 28,000 horsepower.

Production of Slate.

The value of the slate produced in the United States in 1910, according to the U. S. Geological Survey, was $6,236,759, an increase of $795,341 over 1909. Ten states contributed to the output, Pennsylvania and Vermont being the heaviest producers.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

RUTLAND RAILWAY, LIGHT & POWER.

The Rutland Railway, Light & Power Company reports for the year ended November 30, 1911, compared as follows:

	1911	1910
Gross earnings	$314,581	$274,874
Operating expenses	163,433	144,396
Net earnings	151,147	130,477
Interest and taxes	91,413	85,701
Surplus	59,733	44,776

DETROIT UNITED RAILWAY.

The report of the Detroit United Railway for the month of October and ten months ended October 31, 1911, compares as follows:

	1911	1910
October gross	$884,243	$809,455
Operating expenses	578,662	523,058
October net	305,581	286,397
Other income	13,653	12,449
Total income	319,234	298,846
Charges and taxes	177,438	178,429
October surplus	141,796	120,417
Ten months gross	8,511,734	7,837,434
Operating expenses	5,465,905	5,008,483
Ten months net	3,045,829	2,828,950
Other income	144,466	125,656
Total income	3,190,295	2,954,606
Charges and taxes	1,766,127	1,689,549
Ten months surplus	1,424,167	1,265,057

NEW YORK STATE RAILWAYS.

The report of New York State Railways Company for the quarter ended September 30, 1911, compares as follows:

	1911	1910
Total operating revenue	$1,028,835	$947,264
Total operating expense	629,383	559,488
Net operating revenue	399,451	387,776
Taxes accrued	64,023	60,043
Operating income	335,428	327,732
Non-operating income	238,705	121,422
Gross income	574,133	449,154
Total deductions from gross income	150,749	144,880
Net corporation income	423,384	304,274

UNITED TRACTION (ALBANY).

The report of the United Traction Company (Albany-Troy) to the United States Public Service Commission for the quarter ended September 30, 1911, compares as follows:

	1911	1910
Operating revenue	$616,546	$572,715
Operating expense	373,570	344,246
Net operating revenue	242,976	228,468
Taxes accrued	36,000	33,000
Operating income	206,976	195,468
Other income	53,342	50,120
Total income	260,319	245,589
Charges, etc.	104,849	98,985
Surplus	155,470	146,603

LAKE SHORE ELECTRIC.

The report of the Lake Shore Electric Railway system for the month of October and ten months ended October 31, 1911, compares as follows:

	1911	1910
October gross	$ 107,620	$105,075
Expenses and taxes	58,876	55,940
October net	48,744	49,134
Charges	34,625	34,669
October surplus	14,119	14,465
Ten months gross	1,069,857	1,018,739
Expenses and taxes	565,105	529,101
Ten months net	504,753	489,638
Charges	347,025	347,678
Ten months surplus	157,727	141,961

MANHATTAN SURFACE RAILWAYS.

The operating statistics of the Manhattan Street Surface Railways for the year ended June 30 compare as follows:

	1910	1909
Passenger car miles	55,425,835	55,255,497
Revenue car miles	55,426,013	55,257,284
Transfers (free)	139,011,581	139,607,266
Revenue passengers	*375,888,469	362,077,665
Amount fares	$18,677,788	$17,997,252
Revenue from transportation	18,678,033	17,999,309
‡Operating expenses	8,876,933	9,228,231
Total operating expenses	12,840,596	13,326,858
Maintenance of way and structure	2,369,397	1,813,015
Maintenance equipment	1,594,265	2,285,611
†Operating power	1,130,701	1,188,413
Operation of cars	5,300,073	5,213,125
General expenses	2,446,158	2,826,692

*Reports show "passengers carried, including transfers," of an aggregate number of 571,838,112.
†Operation of power plant, less power sold.
‡Excluding maintenance.

HUDSON VALLEY RAILWAY COMPANY.

The report of the Hudson Valley Railway Company to the United States Public Service Commission, Second District, for the quarter ended September 30, 1911, compares as follows:

	1911	1910
Total operating revenue	$210,068	$231,050
Total operating expense	115,256	137,445
Net operating revenue	94,812	93,605
Taxes accrued	6,750	6,055
Operating income	88,062	87,549
Other income	1,144	968
Total income	89,207	88,518
Charges, etc.	65,010	61,453
Surplus	24,196	27,065

Western Electric Stockholders May Get Extra Dividend.

With but one month still to be heard from in 1911, the gross sales of the Western Electric Company promise to total between $66,000,000 and $67,000,000 this year. Last year gross sales totaled $61,000,000 and $46,000,000 in the preceding year. In 1908 the total was $32,000,000, in 1907 $53,000,000, and 1906 holds the high record with $69,000,000.

Indications of early 1911 promised a record year, but the Western Electric has shared with others the industrial slump, though not to such a marked extent. The eleven months so far reported are about three per cent ahead of the corresponding eleven months in 1910.

November shows a falling off of about three per cent, as compared with November, 1910, practically the whole decrease coming from the Middle West section of the country. Last month the five per cent decrease, in comparison with October, 1910, came from the Eastern section, and the November returns indicate that the area of industrial depression is moving westward. The company's business further West and on the Pacific slope is still ahead of last year's.

AMONG THE CONTRACTORS AND SUPPLY MEN

ARTHUR REYNOLDS of Freeport, Maine, has purchased the electrical business of Fred Brown in Waterville.

THE JAMES RILEY ELECTRIC COMPANY has recently moved from No. 8 Ellicott Street to No. 350 Washington Street, Buffalo, N. Y.

THE DUBOIS CONSTRUCTION COMPANY, St. Joseph, Mo., was awarded the contract for installing 10,000 lineal feet of cable to supply current for seventeen additional blocks of street lights.

WILLIAM A. MULLENS ELECTRIC COMPANY, Tacoma, Wash., has been awarded the contract for installing electric-lighting fixtures in the Veterans' Home, Port Orchard. The price bid was $907.92.

J. E. WILSON is the present name of the contracting firm at Los Angeles, Cal., formerly known as the C. O. D. Electric Works. Mr. Wilson, who organized this company, went to California from the east some years ago.

THE FOULKES ELECTRICAL COMPANY, Los Angeles, Cal., has been awarded a contract for electrical work, including conduits, wiring, etc., in the new Van Nuys office building at Seventh and Spring Streets, of that city, at a cost of $20,350. Morgan, Walls & Morgan, of Los Angeles, are the architects.

THE HOWELL ELECTRICAL ENGINEERING COMPANY, of which H. H. Howell is president and manager, is now the firm name of the company doing a general electrical contracting business at No. 74 East Genesee Street, Buffalo, N. Y. The company was formerly known as the Hancock-Howell Electrical Engineering Company.

Plans for Financing Allis-Chalmers Company.

Plans for the reorganization of the Allis-Chalmers Company were discussed at a recent meeting, whereby it is proposed to put the company on a more substantial basis financially and physically.

The company has a capitalization of $50,000,000, of which $19,820,000 is common and $16,050,000 preferred, and $11,148,000 first mortgage bonds are outstanding.

New Electrical and Mechanical Apparatus and Appliances

The Luitwieler System of Non-Pulsating Reciprocating Pumps.

Users of electric power for pumping purposes generally will be interested in the Luitwieler non-pulsating reciprocating pumps. These pumps are especially adapted for use with electric motors, direct connected on the same base; and, it is said, will effect an average saving of fifty-five per cent on the cost of operation of pumps of other

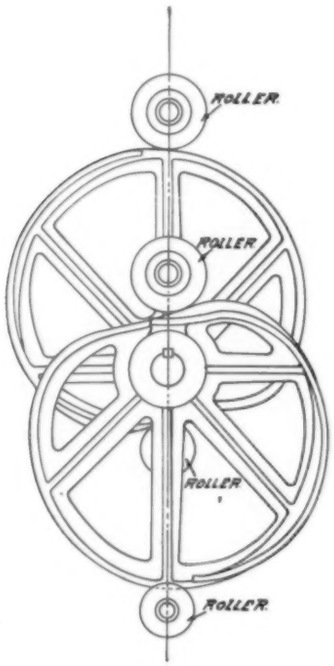
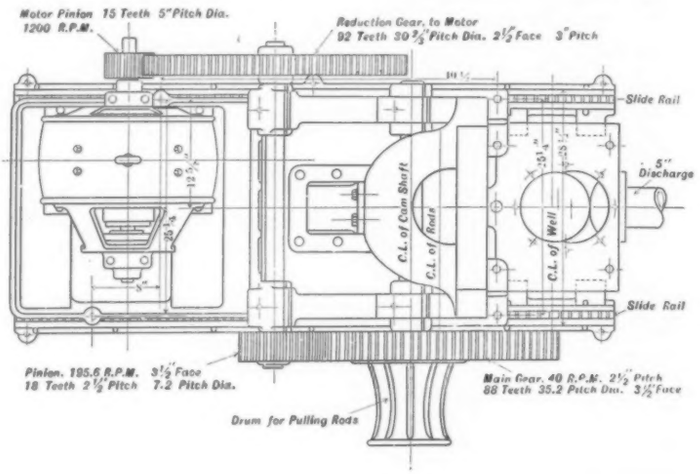


FIG. 1.

types. These pumps are universally adapted to any of the various services and conditions, such as suction, pressure, deep or shallow wells, mines, boiler-feed and for all liquid and semi-fluid matters.

The differentiating mechanical characteristics of the Luitwieler pumping engines are that dead-centers and cranks are done away with; the rotary motion of the power being transformed into a straight line reciprocating movement by cams. A constant, unvarying load is always maintained and there is nothing to cause sparking and arching in the commutators of motors. The resulting water delivery is even and unfluctuating.

The cam arrangement of the duplex vertical model is shown in Fig. 1. The two cams are key-seated oppositely upon one shaft and transmit the power to sliding yokes, the friction being relieved by rollers as shown. These cams are so designed that each lifts the load through slightly more than a full half revolution, the overlap permitting trailing the load off gradually from one cam while the succeeding cam is at the same time gradually assuming the load. The rise of the cam is even and constant between the intervals of overlap, and carries the water load forward without acceleration at one


Motor Pinion 15 Teeth 5" Pitch Dia.
1200 R.P.M.
Reduction Gear, to Motor
92 Teeth 30 2/3" Pitch Dia. 2 1/2" Face 3" Pitch
Slide Rail
5" Discharge
C.L. of Cam Shaft
C.L. of Rods
C.L. of Well
Slide Rail
Pinion. 195.6 R.P.M. 3 1/2" Face
18 Teeth 2 1/2" Pitch 7.2 Pitch Dia.
Main Gear. 40 R.P.M. 2 1/2" Pitch
88 Teeth 35.2 Pitch Dia. 3 1/2" Face
Drum for Pulling Rods

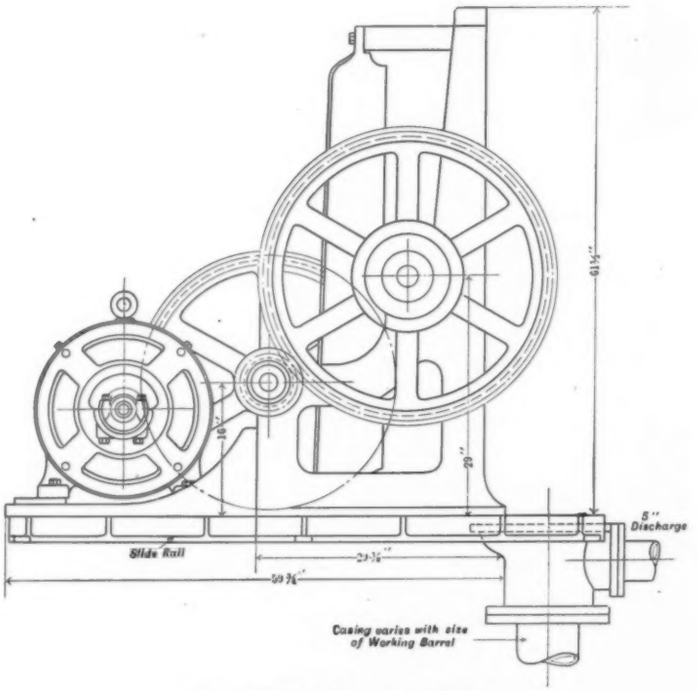


FIG. 2.—PLAN AND ELEVATION.

speed. In Fig. 1 it will be noticed that the upper cam is just reaching its topmost limit of travel, the rotation being counter clockwise, and the lower cam has already started its roller upon the upward movement. In this manner a full load is always carried without diminution or fluctuation.

The power transformed by the cams is applied to the pistons in cylinders at any depth below the pump-head through two balanced sets of rods, hung one from each of the sliding yokes. By means of this arrangement it is always possible to keep the pumping engine at the surface no matter what the depth of the well or shaft may be. As the moving and reciprocating parts throughout the entire equipment are balanced in weight there is very little inertia and operation is effected upon much less power than ordinarily is required.

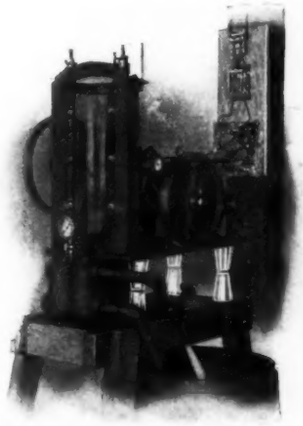


FIG. 3.

Fig. 2 shows a fifteen-inch stroke Luitwieler pumping engine designed for duties up to ten horsepower, arranged as a self-contained unit of motor and pump on one base, direct connected. Both larger and smaller sizes are built on these lines for all kinds of duty, from four-inch stroke boiler-feed pumps to eighteen-inch stroke with capacities of 62,000 gallons per hour. They are also built in units with steam and gasoline engines, and for belt drive and windmill application.

Owing to the fact that these machines are free from all vibration, jar and noise, and because they do not require heavy foundations, they are adapted for use in tall buildings for water supply and fire protection, being installed upon the fourth or fifth story to which the city mains will usually raise water, saving pumping through that height. When used with electric motors the operation is rendered entirely automatic.

An interesting demonstration of this pump was conducted at the recent Canadian National Exposition in Toronto. The electric pumping engine demonstrated here (Fig. 3) was operated at full capacity while standing upon eight water glasses standing in pairs bottom to bottom upon a wooden sawhorse. A lead pencil standing on end on top of the machine is plainly visible and proves conclusively the absence of all vibration. The length of exposure while this picture was being taken was eight minutes.

The Luitwieler Pumping Engine Company, of Rochester, N. Y., is the manufacturer of these pumps.

Red Electric Washing Machine.

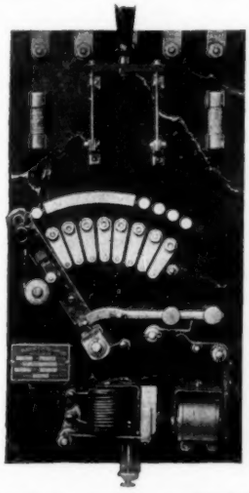
The Hurley Machine Company, Chicago, Ill., has brought out a new type of washing machine which makes use of the dolly principle. The special patented feature of this machine is the method of operating the dolly. It is operated by an upright shaft extending up through a hollow sleeve in the bottom of the tub. This leaves the sides of the machine, as well as both the inside and outside of the cover, entirely free from any mechanism to interfere with the operation.

It is claimed that this is the only machine of the dolly type which is equipped with a wringer which can be used at the same time as the washer. The wringer is reversible and has been especially designed for this use. It is operated by the same motor that operates the washing machine. The motor is of Westinghouse make and is mounted on a metal platform beneath the bottom of the machine, and out of the way of the operator. This platform is rigidly attached to the legs, which insures perfect alinement of the gearing. A drain faucet is supplied in the bottom of the tub. As the cover is entirely free from all mechanism, it can be raised or lowered at any time without interfering with the operation of the machine. These machines are guaranteed for three years.

An order for 500 cars of the near-side type has been placed by the Philadelphia Rapid Transit Company. A previous order called for fifty cars of the same type.

Universal Speed Regulator.

Easily removable and replaceable parts are a feature of the compound universal speed regulator which is manufactured by the Independent Electric Manufacturing Company of Milwaukee, Wis., and which is illustrated here. As seen in the photographic reproduction the lower set of segments are connected to the series resistance, and as the handle moves to the right the speed increases by cutting resistance out of the armature circuit until normal speed is reached. On reaching the upper points a few steps of resistance may be put in the field circuit, increasing the speed above normal. The rachet arrangement permits the handle to be left in any position. With a large amount of stopping and starting such a ratchet will be worn in the course of time, when it is easily replaced. In some types of starters in which a notched piece is cast on the lever, the replacement is a more serious matter; a state of affairs which caused attempts at filing new notches, and the employment of makeshifts to hold the lever in position. Here the difficulties caused by wear are remedied by the simple expedient of putting in a new ratchet bar. Another novel feature of this controller relates to the method of regulating the brush pressure. The contact brush is held by a spring whose tension may be easily and quickly regulated by a thumb screw. This may be seen in the illustration. Brush and segments as well as the ratchet bar are easily replaced.



UNIVERSAL SPEED REGULATOR.

The controller of this type is made for shunt and compound motors in sizes ranging from one-eighth to fifty horsepower for standard direct-current volt-

ages. The armature resistance provided is designed for a speed reduction of fifty per cent below normal, and the speed increase due to the insertion of field resistance is from twenty-five to thirty per cent above normal.

Buffalo, Rochester & Pittsburgh Railroad to Use Telephones for Train Dispatching.

The Buffalo, Rochester & Pittsburgh Railroad has placed an order with the Western Electric Company for equipment to be used in connection with the introduction of train dispatching by telephone on a part of its system. Two separate train-wire circuits will be installed. One will extend from Rochester to East Salamanca, N. Y., a distance of approximately 110 miles, with the dispatcher at Rochester, and the other from Buffalo, N. Y., to East Salamanca, a distance of approximately 65 miles, with the dispatcher at the latter place. Provision will be made for establishing through connections between Buffalo and Rochester.

The apparatus ordered will provide equipment in all for fifty-five selector stations, and for the dispatchers' offices. Test panels are provided at way stations to permit of the use of the telegraph instead of the telephone wires, as desired. Apparatus is also to be supplied to enable various officials to listen in on the circuits and supervise the service.

A special feature is to be provided for about twenty way stations. This consists of a box, to be placed outside of each of these station buildings, containing equipment which will enable a train crew to get in touch with the dispatcher when the way station is closed at night. Connection is made to the line through the regular station wiring by means of a door switch and every train on each division will carry a portable telephone set which need merely be connected to the box equipment in order to communicate with the dispatcher.

Large Induction-Motor Order.

The General Electric Company, Schenectady, N. Y., has received an order from Nordyke & Marmon Company of Indianapolis, Ind., for eighty-two induction motors.

Oil Production in Illinois.

Illinois produced in 1910, 33,143,632 barrels of oil, valued at $19,669,383.

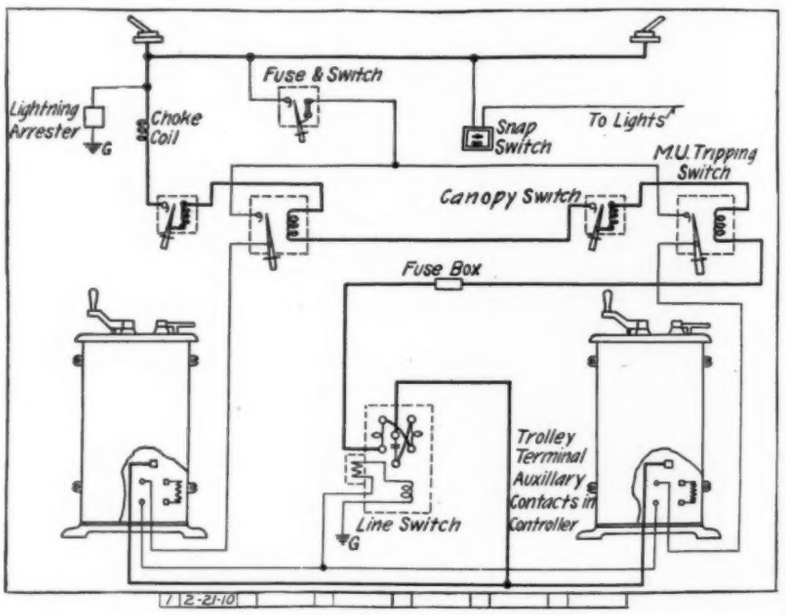
Electro-Pneumatic Line Switch.

Power-operated switches for main circuits on electric railway cars insure effective and reliable control. Wear and tear on drum controllers may be greatly reduced and the life of the contacts correspondingly increased by the use of these auxiliary contactor equipments.

A Westinghouse conta tor equipment consists of a pneumatically operated line switch or "contactor" mounted beneath the car and connected to the main reservoir of the air-brake system. The switch is controlled by means of a magnet valve, which is operated by current from the trolley. The circuit to this magnet valve is carried through a pair of auxiliary contacts located on the drum of the controller. When the handle is moved toward the "off" position, the circuit of the auyiliary contacts, and hence the circuit of the magnet valve, is broken before the main power circuits are broken; and thus the main power circuit is always opened by the powerful pneumatically operated switch beneath the car rather than by the controller contacts.

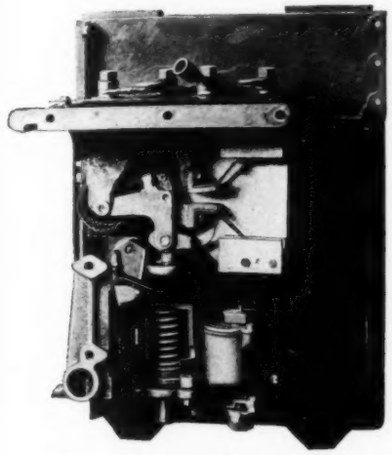
The auxiliary circuit is carried also to a small tripping switch, located near each controller, and corresponding to the usual car circuit-breaker. This switch is so arranged that an overload or "short" in the main circuit will release the handle of the tripping switch, thus opening the auxiliary circuit and causing the contactor to open the main circuit. The contactor connection outfits are evident from the schematic diagram. The air supply for operating the contactor is carried through an auxiliary reservoir and a check valve before passing to the pneumatic cylinder. Although, from the standpoint of safety, it is usually undesirable to attempt to operate a large car unless the air brakes are in good working order, this reservoir gives a large reserve supply of air for operating the contactor if desired, even if the main air supply should fail.

To secure the best results from the contactor, a special handle should be used on the controller. This handle is so arranged that in ordinary operation the drum of the controller is moved toward the "off" position only far enough to open an auxiliary circuit, and thus it opens the contactor without opening the main circuit on the controller drums. Where such a handle is used the opening and closing of the main circuit is not done at the controller drum. The controller serves merely to cut the resistance in and out and to connect the motors in series or parallel. The special handle is so arranged, however, that in case of emergency it is only necessary to press a release button on the handle and the controller may then be thrown to the regular "off" position, in which the main power circuit is broken on the drum, as well as by the contactor.



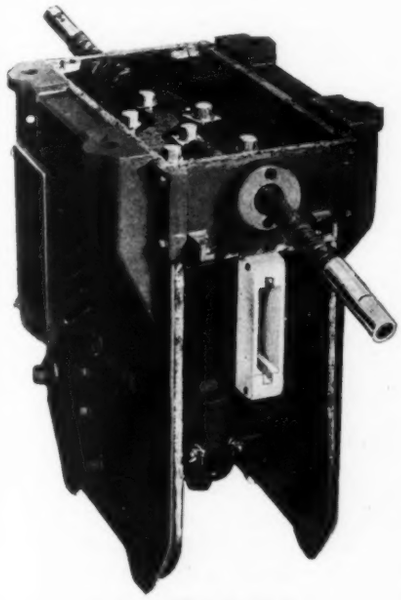
WIRING FOR ELECTRO-PNEUMATIC LINE SWITCH.

The Westinghouse Electric & Manufacturing Company states that in addition to the saving in wear upon the controller contacts and consequent reduction in maintenance cost, the use of Westinghouse pneumatically operated



SWITCH WITH COVER REMOVED.

contactors effects other economics. It is well known that burn-outs and explosions upon the platform frequently cause such alarm among passengers that injuries and damage suits result. Operation of the arc-breaking contacts



ASSEMBLED SWITCH.

of the main power circuit by the pneumatic line switch underneath the car, and the restriction of the current ordinarily broken by the controller to the small amount necessary for the magnet valves, eliminates this danger. The utilization of air pressure for power renders the operation of the contactor practically independent of fluctuations of line voltage.

The Deflection Potentiometer.

It is generally understood that the potentiometer is an instrument for measuring the magnitude of any direct voltage by balancing it against an equal voltage whose value is known. The known values are obtained by sending a steady current through a series of known resistances and determining the drop of potential per unit of resistance by means of some known voltage, such as the electromotive force of a standard cell. In the ordinary forms of potentiometer the resistances are arranged either in the form of a series of dials or else in the form of a slide wire, and the contacts on the dials or the slide must be adjusted until a balance of the electromotive forces is indicated by the absence of any deflection in a galvanometer or other detecting instrument. In order to obtain the balance necessary for making a reading, it is almost essential that the electromotive force to be measured should have a constant and not a fluctuating value, and even under the best conditions some little time is usually consumed in getting a reading, especially by those not accustomed to the use of the instrument. The use of the potentiometer has consequently been largely confined to laboratory work, where steady conditions are possible and accurate readings are necessary. For work of less accuracy where conditions are less steady, or where time consumed is a consideration, the potentiometer has been excluded and the ordinary forms of indicating instruments have been depended upon almost exclusively for readings of direct voltage.

An instrument combining the advantages of the potentiometer and the direct-reading instrument has been designed by H. B. Brooks of the Bureau of Standards and is manufactured by the Leeds and Northrup Company, Philadelphia, Pa. It is known as the deflection potentiometer. The principle of this instrument is to make use of the general arrangements of the ordinary potentiometer, but instead of getting an exact balance of electromotive forces, to quickly get an approximate balance and read on an indicating instrument the value of the voltage which represents the lack of balance. A quick setting of a single dial thus gives the approximate value of the unknown voltage, and the reading of a pointer on a scale gives the exact difference between this approximate value and that being measured.

The instrument used for indicating the lack of balance is built by the Weston Electrical Instrument Company and really constitutes a low-reading voltmeter. It replaces the ordinary galvanometer which is generally used with the potentiometer to indicate a balance. It is necessary then to have the deflections of this instrument proportional to the excess of voltage which remains unbalanced after the setting of a single dial. This can be done by a proper choice of resistances in the designing of the instrument.

FIG. 1.—DEFLECTION POTENTIOMETER.

Fig. 1 is a view of the complete instrument containing the Weston meter, a dial at the right for setting to the nearest five volts, a rheostat at the left for adjusting the current to the proper value in the coils of the potentiometer, and the necessary plugs and switches used in operating the instrument. In addition it is necessary to have a storage battery or other source of steady current, and a standard cell which is used in adjusting the current to the proper value.

It is not necessary that a voltage be

constant in order to be measured on this instrument. If the fluctuations come within the range of the deflecting instrument these variations can be followed as easily as upon any other direct-reading instrument, and as this instrument is dead-beat, an average value may easily be read, or if the voltage becomes constant for even a brief interval its value may be read off. This is a very important point in connection with the calibration of instruments, as it is often sufficient to get a single simultaneous reading upon a circuit where the voltage is unsteady. By means of a volt-box it is possible to use the instrument for any range of voltage that may be desired, and by the use of a set of shunts it is also possible to use this instrument for measuring currents of any range of value. It thus forms a very useful instrument for central stations, testing laboratories and other places where it is necessary to have an instrument slightly more accurate than any direct-reading instrument for use in calibrating the latter, and yet where considerations of steady voltage and rapidity of operation render the ordinary potentiometer unsatisfactory.

New Equipment for Lehigh Valley Transit Company.

The Lehigh Valley Transit Company has purchased thirty-one new cars for service over the following four lines comprising this system: Slatington, South Bethlehem, Allentown and Chestnut Hill, and the Bethlehem and Nazareth lines. These cars were built by

TRAIN LINE JUMPER.

the St. Louis Car Company and the trucks used are the Baldwin bolster type built by the Baldwin Locomotive Company.

All of these cars are equipped with quadruple Westinghouse No. 304 interpole motors and Westinghouse HL control arranged for operation from either end of the car. They are also provided with train-line jumpers and receptacles so two or more cars can be operated in a train from one master controller. The Westinghouse No. 304 motor is of the interpole type, has a split frame, and is rated at 75 horsepower at 500 volts and 90 horsepower at 600 volts.

There are many advantages in the split-frame type of construction to roads operating from 5 to 50 cars because the armature and the interior of the frame are accessible for inspection and repairs, without jacking up the car, running out of the truck, and removing the motor from the truck, which takes time and causes delay. On a split-frame motor, the lower half of the frame can be dropped downward and a thorough inspection can be made from a car-barn pit by an inspector and helper. In many instances, complete repairs can be made and the car returned to service in a remarkably short time. The resultant time saved is often of great value especially when there are no available extra cars to send out, or no spare motors on hand to substitute for the defective one. And frequently a lone inspector working at night can make repairs to several cars equipped with drop-frame motors and have them ready for service in the morning without interrupting the schedule.

TRAIN LINE RECEPTACLE.

The axle and armature bearings used in this motor are provided with a separate oil pocket so that an inspector can pour oil into the pocket. The oil will pass down to the bottom of the housing and then feed upward, through a compartment filled with waste, to the journal. This method effectively prevents any grit being carried by gravity with the oil down to the bearing. It also enables an inspector to measure the quantity of oil in the well before pouring in an additional supply. This results in considerable economy of oil consumption. A large number of operating companies using this type of bearing report that it is necessary to replenish the oil but once a month. Westinghouse HL control, which is used on these cars, offers many advantages over the old platform type controller. A small master controller is used which requires a minimum amount of space on the car platform, and all the heavy current-carrying parts are located beneath the car, which reduces to a minimum all possibility of frightening or injuring passengers from controller blow-outs. All the contacts in HL control are held together under heavy pressure pneumatically, irrespective of line voltage. This form of control also permits the cars to be operated either singly or in trains.

New Single-Phase Converter.

To meet the demand for a single-phase converter, the full equivalent mechanically of a motor-generator set in a single unit, capable of operation from single-phase alternating-current supply, the Wagner Electric Manufacturing Company, St. Louis, Mo., has produced the device shown in Fig. 1. This converter is offered in several capacities, adapted particularly to the following purposes: Battery charging for electric vehicles, moving picture and theatrical work, X-ray, charging telephone batteries, energizing telegraph systems, railway-signal work and miscellaneous industrial uses.

FIG. 1.—WAGNER CONVERTER.

The equipment consists essentially of the following parts: (A) The converter proper (Fig. 1) constituting in itself both a device for changing alternating current to direct current through the medium of a revolving armature, as well as a motor for the delivery of power either from direct current or single-phase alternating current. (B) A controlling switchboard, for connecting the same to the source of alternating-current supply and controlling the amount of direct

current delivered to the battery, etc.

From Fig. 1, it will be seen that the converter is an exceedingly rugged device, possessing all the outward characteristics of the standard single-phase alternating current motors built by the Wagner Company. The frames are substantial, the bearings liberal, and construction, in all respects, rugged. Instead of the usual phosphor-bronze sleeve bearings, these converters are supplied with ball bearings, thus simplifying the matter of lubrication and also increasing the performing efficiency of the device.

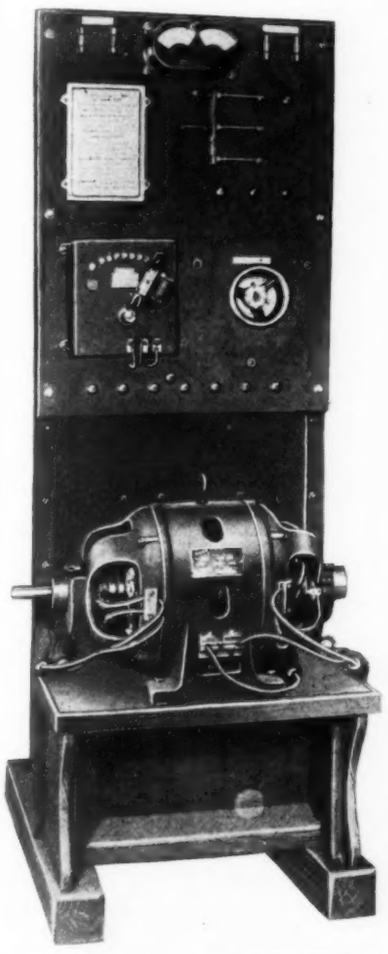


FIG. 2.—CONVERTER AND SWITCHBOARD.

The switchboard carries switches, meters and regulating devices for fully controlling the starting of the converter and regulation of its output of direct current under all conditions and requirements of charging service. The switchboard may or may not be equipped, as desired by the user, with automatic devices for cutting out the battery when fully charged.

This single-phase converter offers a particularly ideal equipment for the private garage. It is not subject to "breakage" and its wear will be so gradual as to make maintenance charges of all kinds practically nil. In manipulation it is simple and easily within the control of any member of the family or employee capable of driving the electric car.

As a power motor, it will have a wide variety of usefulness in the private garage. For example, it can be used to drive tire pump, polishing wheel, laundry equipment, machinist's lathe, vacuum-cleaner equipment, or any other forms of household devices requiring motor drive.

While the converter shown in Fig. 2 is placed in close proximity to the switchboard, there is no limitation in this respect. It may be placed at any convenient point, suspended from the wall or from the ceiling of the garage. When used as a motor, it may simultaneously be employed for delivering charging current in reasonable amount.

It therefore becomes a most admirable central-station adjunct, as it affords for the central station, a device through which a domestic-power load can be acquired simultaneously with a vehicle-charging load.

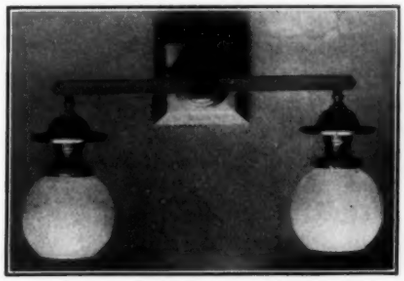
Mazda Lamp Installation in Iowa College.

The Iowa State College of Agriculture and Mechanical Arts, located at Ames, Iowa, has recently been equipped throughout with Columbia Mazda lamps. This well-known agricultural college covers an area of approximately 1,200 acres. There are twenty-one large buildings and many smaller ones, making a total of fifty-five built or in course of construction, which along with their furniture are valued at about $3,500,000.

TTC Wall Fixtures.

The side-wall fixtures here illustrated comprise an interesting new development in the line of TTC Tungstoliers, manufactured by the Tungstolier Company of Conneaut, O. TTC fixtures are constructed on the sectional principle, all parts—arms, bodies, canopies and stems—being so interchangeable that with 86 parts it is possible to make up 1,944 absolutely different fixtures, ranging in design from simple types for the small residence to the most ornate equipment for public buildings. Also it is possible to increase the number of lights on a chandelier fixture from two to three, four or more, by simply inserting and re-positioning the arms.

In addition to the chandelier types of TTC fixtures, which were described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, October 28, there are now available a companion series of side-wall brackets, built up from the same sectional components as shown in the accompanying illustrations, and as



TWO-LIGHT WALL FIXTURE.

readily adaptable to all conditions of service. With this development the TTC line offers the fixture dealer the novel opportunity of doing business without the traditional "inverted forest" that marks the show-room of the dealer in "regular" fixtures. Moreover, these Tungstoliers are packed in square pasteboard cartons and the stock is stored on shelves out of the way and free from dust and danger, for the salesman demonstrates the line by the manipulation of a single complete set of fixture parts. From the salesman's point of view this is the greatest advantage of TTC Tungstoliers, as the customer sees one fixture type at a time, instead of a hundred. There is consequently less confusion and indecision and that saves the dealer's time.

SINGLE-LIGHT WALL FIXTURE.

Improved Electric Steel Sheets.

The requirement of the manufacturers of electrical machinery for core material which will have low hysteresis and eddy-current losses and high permeability has led the Follansbee Brothers Company, Pittsburgh, Pa., to put upon the market two lines of sheet steel which fully meet the manufacturers' demands. The accompanying curves illustrate the properties of these materials. Fig. 1 shows the data for core loss and permeability in the improved electric steel, and Fig. 2 gives core-loss data for the special transformer steel. These sheets are intended for use in the manufacture of motors, transformers and other electrical machinery.

The mills of Follansbee Brothers Company are located at Follansbee, W. Va., in the Pittsburgh district, and include open-hearth works and motor-driven mills with chemical, metallurgical and electrical laboratories. They are thus prepared to give complete records of tests to the purchasers of sheet steel. The best quality of open-hearth metal is used in the production of these sheets. As a means of increasing the density and thereby improving the permeability, the metal is not merely rolled, but is hammered by an enormous hammer which strikes blows of 800 tons. This welds together the particles of the metal and causes a great improvement over the ordinary rolling operation.

The transformer steel consists of high-silicon alloy and the uniformity of this material is guaranteed, the values shown in the curves representing a core loss which is not exceeded. This positive guarantee makes it possible for the manufacturer to depend upon the magnetic properties of these sheets. It is customary to give complete records of tests to buyers of sheets. Samples in quantity sufficient for making tests may be obtained free of charge.

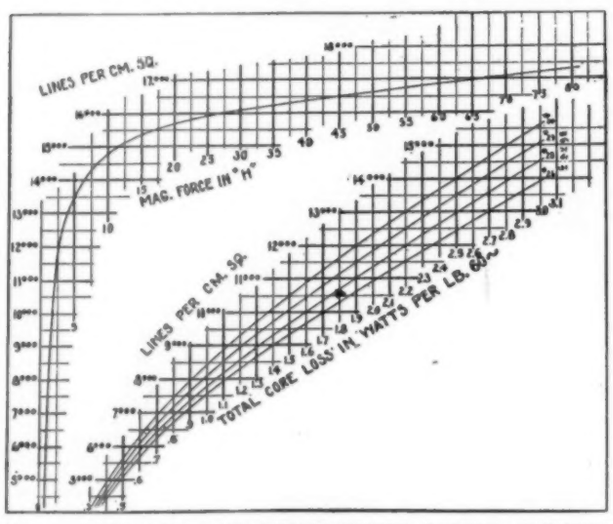


FIG. 1.—CORE LOSS AND PERMEABILITY CURVES, ELECTRIC STEEL.

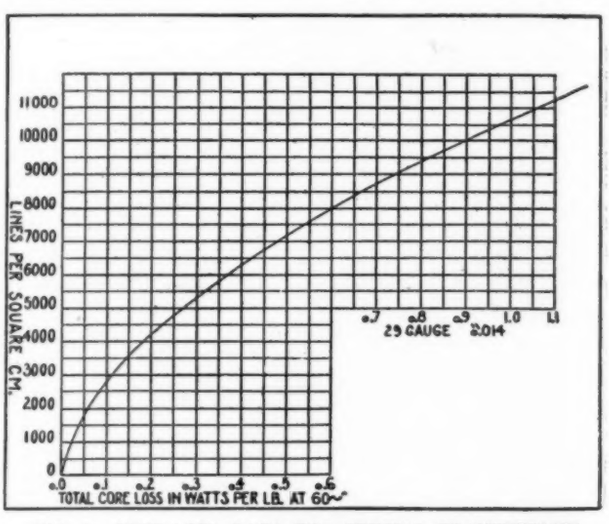


FIG. 2.—CORE-LOSS DATA FOR SPECIAL TRANSFORMER STEEL.

Aluminum Traction Coils.

In a recent issue we directed attention to the value of aluminum wire when used for the field coils of traction motors. This material has been employed with distinct success for traction work, and it is likely to grow in favor among railway managers, because it considerably lightens the car equipment. In a pamphlet just issued by the British Aluminum Company, London, England, some additional details are given of the value of aluminum in traction service. The data are reproduced herewith.

	Aluminum.	Copper.
Number of turns	200	200
Size of wire	0.173	0.155
Temperature rise (degrees centigrade)	75	75
Ampere-turns at rated load	9,000	9,000
Total weight of coil, pounds	29	68
Average cost of coil	$15	$21
Cost reduction per car (two motors)	$24	...
Weight reduction per car (two motors)	156	...

It is pointed out that 8,000 of these aluminum coils are in service; further, that aluminum is extensively employed for railway feeders, collector bows and trolleys, car wiring, controller and contactor parts and connections, interior paneling and fittings. It will be noticed that the copper field coil is more expensive than the aluminum, and that the total weight reduction on a car (two motors) amounts to as much as 156 pounds.

Lake Shore & Michigan Southern Installs Telephones for Message Service.

The Lake Shore & Michigan Southern Railroad is preparing to install telephones in order to open message circuits on two of its divisions, and has recently placed an order with the Western Electric Company for the entire apparatus to be used for this purpose.

The message circuits, which will be used mainly for the transaction of miscellaneous railway business between division and intermediate points, will parallel existing circuits used for dispatching trains by telephone and will extend from Toledo, O., to Elkhart, Ind., a distance of approximately 145 miles, and from Fort Wayne, Ind., to Jackson, Mich., a distance of about 100 miles. Thirty-three selector stations will be equipped on the first-named division and twenty-two on the latter, and No. 9 B. & S. copper used for the line wire. The message operators will be located at Toledo, O., and Hillsdale, Mich., respectively.

Roebling Works at Trenton Damaged by Fire.

A fire broke out on December 2 in the flat-copper and steel-wire department of John A. Roebling's Sons Company's factory at Trenton, N. J. The shop affected is used in the manufacture of special wire, but the company states that the other shops have ample capacity to take care of the extra work thrown upon them. The fire will not delay the company in filling its contracts and orders.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, has received a petition for a proposed new electric railroad company operating between the cities of Buffalo and Rochester. The proposition involves the consolidation of the Buffalo & Williamsville Electric Railway, the Buffalo & Depew Railway and the Buffalo, Genesee & Rochester Railway, under the name of the Buffalo, Batavia & Rochester Railway Company. The proposed route of the Buffalo, Batavia & Rochester Electric Railway will form an extension of the Buffalo & Williamsville Railway and the proposed route of the Buffalo, Genesee & Rochester Railway will form a continuation of the Buffalo & Depew Railway. These proposed routes join near the village of Batavia, and will form one continuous connected line of railway.

The Commission has authorized the Central New York Gas & Electric Company to exercise rights and privileges under franchises granted by the village of Newark and the town of Manchester. The company is restricted to the exercise of the franchise in the easterly half of the town of Manchester, the remaining part of the town now being occupied by another company.

The Keeseville Electric Company has been authorized to execute a mortgage on its plant and property for $500,000. The company is also authorized to issue presently $70,000 in twenty-year six-per-cent first-mortgage bonds, $30,000, of which shall be used to take up existing bonds par for par; $40,000 of which shall be used for the construction of a transmission line to Ausable Forks from Ausable Chasm and local lines at Ausable Forks, and for electric apparatus and improvements to the power house.

The Public Service Commission, Second District, has received an application from the Western Union Telegraph Company for a rehearing upon the order recently made by the Commission directing that company to discontinue its practice of charging the Postal Telegraph-Cable Company for certain words inserted on telegrams received from the Postal for further transmission over the lines of the Western Union Company. The Western Union Company will ask for a modificaton of the order made, so that it will be allowed to charge for the name of the place and the state where the message originated, and the word "via" so that three words will be charged for instead of the number of words at present charged for, which is, according to circumstances, four or five.

COMMISSION NEWS FROM CONNECTICUT.

(Special Correspondence.)

A number of residents of Camden County appeared before the State Board of Public Utility Commissioners protesting against rate discriminations made by the Delaware & Atlantic Telephone Company. It was claimed that through a new adjustment of rates the schedule is increased to such an extent that they are unjust and discriminatory. It was pointed out that the rates now charged were particularly unfair to large subscribers like the business houses. An attempt was made to show by statistics the alleged unjust discrimination and it is the intention of the complainants to produce additional testimony to convince the board of the unreasonableness of the rates. A representative of the legal department of the Bell telephone system, attempted to show that the increases were necessary to abolish certain discriminations which were violations of the present Public Utilities law. Claim was made that for the company to meet the demands of the business men of Camden would render it liable to prosecution under the new statute. The counsel for the prosecutors refuted this statement and said that testimony could be presented to show that if a fair adjustment of rates was made it would not have to be exorbitant and still would not be in violation of the intent of the utilities law.

COMMISSION NEWS FROM OHIO.

(Special Correspondence.)

The Public Utilities Commission of Ohio has dismissed the appeal of the Bucyrus Light & Power Company, which sought authority to increase its rate schedule over the rate fixed by ordinance of the city. The Commission held that the rate-making ordinance was in force prior to the enactment of the law providing for the Commission, and that it was therefore without power to grant the relief sought.

The Commission also took up the protest of Oliver Goldsmith against a minimum monthly charge made by the Cincinnati Gas & Electric Light Company. The charge has been in force for some time. Another matter which is to receive the attention of the Commission relates to the placing of meters.

LIGHTING AND POWER.

(Special Correspondence.)

GALVA, IA.—Bonds have been voted for the installation of an electric light plant. C.

KAMRAR, IA.—The business men contemplate installing street lights of some kind. C.

BELLINGHAM, WASH.—A municipal hydroelectric power plant is under consideration.

SEATTLE, WASH.—The Seattle Lighting Company is to extend its line to Renton.

MT. VERNON, IOWA.—W. S. Tasker has been granted an electric-light franchise here.

LEGRAND, IA.—The citizens have asked for the construction of an electric lighting plant. C.

OGDEN, IA.—The Boone Electric Company is preparing to work on its proposed line to this city. C.

WICKENBURG, ARIZ.—The Big Blue Mining Company is about to establish a hydroelectric power plant.

SPRING GROVE, MINN.—The Commercial Club is agitating the construction of an electric light plant. C.

MAQUOKETA, IA.—There is an agitation to erect several steel towers with strong arc lights for lighting the town. C.

LORDSBURG, N. M.—The Eighty-Five Mining Company plans for the installation of new air-compressor machinery.

GRAND SALINE, TEX.—The municipal electric light plant here, which was recently destroyed by fire, will be rebuilt. D.

MICHIGAN, N. D.—The council is considering a proposition which has been made for the installation of an electric light plant. C.

HITEMAN, IA.—The I. O. O. F. lodge has passed a resolution to install a power plant that will give electric light to anyone desiring it. C.

LA GRANDE, ORE.—The Eastern Oregon Light & Power Company will install new electric power machinery in the Grand Ronde district. A.

JERSEY CITY, N. J.—The United Light & Power Company of New Jersey has recently been incorporated with an authorized capital of $3,000,000.

MIDDLETOWN, MD.—A transmission line is to be built between Braddock Heights and this city and the power will be supplied for electric lights.

MODOC, CAL.—The Provident Investment Company, Los Angeles, plans for the installation of an electric-lighting and telephone system at Modoc. A.

SEDRO-WOOLLEY, WASH.—The Bellingham & Skagit Interurban Railway Company has been granted a fifty-year electric-light franchise at Sedro-Woolley. A.

KENNETT, CAL.—The Sacramento Valley Power Company is building a power line from its substation here to the Uncle Sam mine four miles west of town.

NEEDLES, CAL.—The Needles Gas & Electric Company has been incorporated by Henry Torchiana, A. Mildreth and B. L. Deyoe, with a capital of $100,000. A.

SALTON, TEX.—The Commercial Club is promoting the installation here of an electric-light plant. It is also arranging for the establishment of an ice factory. D.

CALGARY, ALTA.—The estimated cost for the extension of lighting system is about $175,000. Most of the work will be done in Crescent Heights and North Hill. C.

PERU, IND.—Arrangements have been made by the city to take over the private electric lighting plant of Godlove Conradt. About $59,000 is to be paid for the installation.

GOLDFIELD, NEV.—The Goldfield Deep Mines Company will install a 250-horsepower electric hoist and new air compressor equipment. J. R. Clark is head of the company. A.

MILWAUKEE, WIS.—The council is considering the purchase of machinery and equipment for the proposed municipal electric light plant before installing a pole line and system. C.

DULUTH, MINN.—The Duluth & Iron Range Railroad contemplate putting in 3,000-candlepower arc lights at Thirtieth, Forty-seventh, aad Sixtieth Avenues, E., in the near future. C.

WINNIPEG, MAN.—M. Peterson, secretary, will receive bids until December 29, 11 a. m., for the delivery and erection complete of a vertical-centrifugal pump driven by induction motor. C.

ROYERSFORD, PA.—At a recent election the citizens of Royersford voted for a loan of $30,000, to erect an electric light plant.

SEATTLE, WASH.—Preliminary borings have been started at the site of the proposed power dam on Cedar River to determine the character of the subsoil. The plant will cost $1,400,000. C.

LONE OAK, TEX.—The City Council has granted a franchise to J. M. Carsey, of Greenville, Tex., W. J. Simpson and J. C. Simpson, of Kaufman, Tex., to install an electric-light and power plant in this town. D.

TIMPSON, TEX.—The Timpson Light & Power Company was recently incorporated with a capital stock of $5,000. The incorporators are J. P. Christopher, Glen Corwine, and George M. Bliss.

MOUNT VERNON, S. D.—A new electric lighting system is to be installed at Mount Vernon. The downtown district is to be provided with cluster lights and the residence district with suspension lights.

AURORA, MINN.—D. A. Reed, engineer, is promoting the development of an electric water-power plant on the St. Louis River, and proposes to transmit power to various cities on the range. C.

ROSLYN, WASH.—The Kittitas Railway & Power Company will build a hydroelectric power plant near Cle Elum in connection with the new interurban to run between that mining district to Roslyn.

ROME, N. Y.—A new transmission line is to be extended from Trenton Falls to Rome by the Utica Gas & Electric Company. The line will pass over a private right of way and will be strung on steel towers.

PARRAL, MEX.—The Parral Power & Reduction Company has sold its electric power plant near here to the Alvarado Mining & Milling Company. The purchaser will make enlargements and improvements to the plant. D.

BATTLE CREEK, MICH.—Conduits and electric cables have been laid for a new lighting system for the streets of this city and the poles have been received. It is expected that the system will be in operation by Christmas.

NEW SHARON, IA.—The plans for the Oskaloosa Traction & Light Company for the transmission of light and power from Oskaloosa to this city are now nearing completion. Construction work will be started in the near future. C.

STAYTON, ORE.—The Sanitam Light & Power Company, of Stayton has been incorporated by A. L. Shreve, W. J. Mayo and S. L. Stewart, with a capital of $25,000. The company is a subsidiary of the Stayton Electric Light Company. A.

GALVESTON, TEX.—The Cities Service Company has recently purchased the Brush Electric Light and Power Company of this city and intends spending much money in developing it and bringing it up to the high standard of their other properties.

WASHINGTON, D. C.—Engineer James K. Hendricks has been surveying for an electric power line from the Winchester and Washington plant at Millville, W. Va., to Brunswick, Md., to run in a nearly straight line over the Blue Ridge Mountains.

GREENVILLE, TEX.—The company which will erect an electric light plant in Lone Oak has ordered $10,000 worth of machinery for the plant. The company is composed of J. C. Simpson, W. J. Simpson, J. W. Simpson, Ross Simpson and C. R. Simpson.

BOWLING GREEN, O.—The Council has awarded a ten-year contract to the Lake Erie, Bowling Green & Northern Railway Company for lighting the city. Not less than seventy-two arc lights will be used on the streets, for which the city will pay $75 per year. H.

SAN FRANCISCO, CAL.—The Feather River Power & Irrigation Company has been incorporated by R. K. Barrows, Larkspur; A. N. Lewis, Jr., Alameda; A. H. Dahl and H. G. Hill, San Francisco; F. C. Van Deinse, Berkeley, with a capital stock of $10,000,000. A.

KEOKUK, IOWA.—The Keokuk Electric Company has incorporated with a capital of $650,000 to operate railways and produce and distribute gas, electricity, etc. George Higginson, Jr., Joseph L. Valentine and Robert H. Van Deusen are at the head of the project.

MARION, IND.—It is stated that the American Gas & Electric Company has purchased the Alexandria and Fairmount lighting plants from the National Light & Power Company and will take possession January 1. Extensive improvements are planned by the company. S.

STANTON, NEB.—The City Council has decided to build an addition to the present power house, and to purchase a 100-horsepower steam engine and a 125-horsepower steam boiler, the machinery to be installed as soon as possible, together with the new dynamo.

DAYTON, OHIO.—A company has been formed to harness the waters of the Big Miami River at Woodsdale, between Hamilton and Middletown, for power for an immense lighting plant. The object of the company is to furnish electricity to both Hamilton and Middletown.

PHILADELPHIA, PA.—The United Hydro-Electric Power Company of Manhattan has been incorporated with a capital stock of $100,000. The incorporators are: Frank B. Schanne, New York; John C. Williams, Brooklyn; Frederick M. Livingston, New York City.

FALLON, NEV.—The City Council will soon call for bids for the erection of an electric-lighting plant and distributing system, plans for which have been accepted. Electric energy will be obtained at high voltage from the government hydroelectric power plant at Lohonton Dam. A.

LOS ANGELES, CAL.—Upon the application of the Los Angeles Railway Company the City Council will receive bids up to December 19 for an electric-railway franchise for a period of twenty-one years on Vermont, Vernon and Central Avenues, Jefferson and Thirty-eighth Streets. A.

WINSTON, MONT.—The East Pacific mine plans for the installation of electric power for lighting and operating at its mining properties. A power transmission line about twelve mines long will be constructed. Henry M. Lancaster, Spokane, Wash., is at the head of the company. A.

TOMBSTONE, ARIZ.—The Todd Hydro-Electric Power Company has been incorporated with a capital stock of $5,000,000 to build a hydroelectric power plant near Tombstone. George N. Todd, Francis D. Crable, A. G. Bernard, W. A. Harwood, Jr., and W. P. Miller are incorporators. A.

WEAVER, ARIZ.—The Arizona Power Company has adopted plans for the extension of its electric power transmission system to a number of mines in the Weaver district. The proposed line will pass through the Copper Basin district and the Peoples Valley and will terminate at Alvarado. D.

PORTLAND, ME.—The Southern Idaho Light, Heat & Power Company has been organized with a capital stock of $20,000 to engage in the manufacture, sale and distribution of electric current for light, heat and power. President, Clarence E. Eaton; treasurer, Albert F. Jones, both of Portland.

LOUISVILLE, KY.—H. M. Byllesby & Company has plans under way for the establishment of a hydroelectric plant at Cumberland Falls, in Whitley County, about 110 miles from Louisville. A survey is now being made at the falls but a report as to the feasibility of the plan may not be made until spring.

WEYMOUTH, MASS.—An appropriation of $60,000 has been voted by the stockholders of the Weymouth Light & Power Company for making extensive improvements, among which will be the installation of 1,000-kilowatt Westinghouse steam turbine with LeBlanc condenser, a 400-horsepower boiler and a new stack.

LONE PINE, CAL.—The Public Service Commission, Los Angeles, has granted the petition of the residents of Lone Pine for electric service from the municipal power plants to be installed along the route of the aqueduct. The town must bear the expense of installing a distributing system, substation, and auxiliary equipment. A.

CASTLEROCK, WASH.—The Castlerock Coal, Light & Power Company will build an electric power plant at its mining properties near Castlerock. A modern plant for coal mining operations will be installed. The work is estimated to cost $275,000. The Brown Company, Bailey Building, Seattle, has been engaged to prepare plans and specifications. A.

LITTLE ROCK, ARK.—The Arkansas Hydro-Electric Power Company has been organized and will build a concrete dam on the Little Rock River near Higden. A power plant with turbine generator is to be installed and a continuous power of from 10,000 to 30,000 horsepower will be developed. It is proposed to bring electricity into Little Rock and other nearby points.

MOTTVILLE, IND.—H. E. Bucklin and other Chicago capitalists are to build three large dams on the St. Joseph River; work on the first near Mottville having already begun. The third dam will be built near the mouth of Pigeon Creek and from this dam power will be used to generate electric current to operate the St. Joseph Valley traction line now being operated by gasoline motors. S.

FORT DODGE, IA.—Work on the Northern Iowa Power Company's proposed hydroelectric plant north of here will be started soon. The new dam will be 800 feet long and will give a twenty-one-foot head of water. A maximum horsepower of 2,400 is expected. It is anticipated that the cost complete with machinery will be $240,000. W. W. & D. H. Sterns, Humboldt, Ia., are interested. C.

OAKLAND, CAL.—The Yolo Water & Power Company has been incorporated by L. M. Gove, H. L. Breed, M. S. Hamilton, Charles Gross and J. E. Bowes, with a capital stock of $10,000,000. The company plans for the erection of a hydroelectric power plant and transmission system in Yolo County. The directors are also interested in the recently incorporated Sierra Electric Power Company of Oakland. A.

PEARSON, CHIHUAHUA, MEX.—The Pearson Corporation, which operates the Mexican Northwestern Railway, mining and lumber properties, etc., in this district, plans for the erection of a large electric power plant, with transmission and distributing systems to furnish light and power to Pearson, Colonia Juarez, and

Colonia Dublan. Street-lighting systems for these places are also planned. F. S. Pearson is head of the company. A.

TWO HARBORS, MINN.—August Omtvedt, city clerk, will receive bids until December 18, 8 p. m., for furnishing and installing in water and light plant building one 300-kilowatt, sixty-cycle, single or two-phase generator. Proposals will be received and considered for direct-connected engine and generator, also for rope or belt-driven engine and generator, also for engine and generator separately. Check for five per cent should be enclosed. C.

DAYTON, OHIO.—The Russell Company has recently closed a large deal involving the building of a large power station to develop electricity for a number of plants in both Hamilton and Middletown. Plans by Engineers W. H. Zimmerman & Company of Chicago provide for a new dam twenty-eight feet high which will develop 5,000 horsepower. It is planned to develop electricity at the new plant sufficient to furnish the municipal lighting plant of Hamilton, O.

HARTFORD, MICH.—Anderson Brothers, proprietors of the Hartford electric lighting plant, will seek a franchise at the hands of the voters of the village, probably at the regular village election next spring. The new franchise will contemplate some important improvements, amounting to a complete remodeling of the power plant located at the Anderson mill a mile north of the village, and will also provide for a complete day and night electric service. There is a considerable demand for electric power.

NOBLESVILLE, IND.—The White River Corporation is the name of a company incorporated to take over and complete a dam on White River north of Noblesville, and to carry on the general business of manufacturing, transmitting, distributing and selling electric current to towns and cities and to the public in general for heating, lighing and power purposes. The capital stock is $60,000. Alexander R. Holliday, John H. Holliday, Thomas C. McReynolds, L. C. Boyd, H. McK. Landon and Albert Baker are directors. S.

VULCAN, MICH.—The Peninsula Power Company is installing a hydroelectric plant at the Twin Falls of the Menominee River, and is arranging to extend its prospective electrical service to the Crystal Falls and Iron River districts of Michigan, tapping on its way the Commonwealth and Florence fields of Wisconsin. The transmission lines will follow the right of way of the Northwestern Railroad, which traverses the range from east to west. The Peninsula Power Company has in course of construction a huge concrete dam, 1,110 feet above sea level, and a reinforced concrete and brick generating station. The initial improvement will develop approximately 5,000 horsepower. This eventually will be enlarged. It is expected to have the plant in operation early the coming summer.

DES MOINES, IA.—On behalf of the Des Moines River Power Company, William C. Rigby, of Chicago, presented an application to Secretary of the Interior Fisher for authority to improve the Des Moines River between Des Moines and Keokuk for power purposes and to make the stream available for canal purposes. The company will be unable to proceed with its plans until Congress has given the necessary authority, but the application was presented to the Secretary of the Interior in the hope that he would be able to facilitate matters. The company has had the stream examined by experts who state that the Des Moines River will furnish large amounts of power if properly improved. It is calculated that 25,000 horsepower would be supplied by the river and that this can be sold throughout the Des Moines valley for light and power purposes. Already the company is said to be in possession of valuable interurban properties in the lower part of the Des Moines valley.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SEATTLE, WASH.—Superintendent of Public Utilities A. L. Valentine has recently passed on a franchise for a street car system in Kirkland.

PORT TOWNSEND, WASH.—Local business men have formed a company to install an electric street-car system. The cost is estimated at $35,000. C.

SEATTLE, WASH.—The board of public works has approved plans for a municipal car line from Third Avenue and Stewart Street to Salmon Bay. C.

SACRAMENTO, CAL.—The Board of Trustees has passed an ordinance for the extension of the local electric railway lines through the annexed territory in the vicinity of Whisky Hill.

PLYMOUTH, IND.—The South Bend and Logansport Traction Company has been reorganized for the purpose of completing a traction line from Logansport to South Bend *via* Plymouth.

RICHMOND, VA.—The Richmond Railway & Power Company will shortly ask for proposals for the construction of a supplementary power plant at the foot of Twelfth Street, to cost in the excess of $500,000.

BUTTE, MONT.—The Anaconda Copper Company, operating the Butte, Anaconda & Pacific Railway, will soon commence the electrification of the road. The cost, including main line and branches, is estimated at $1,000,000. A.

McKEESPORT, PA.—It is stated that the Irwin Company is preparing to build its own lines into McKeesport and that the incomplete line from West Newton to Herminie is being financed and work will commence early next spring.

CENTRALIA, WASH.—The Centralia Light & Traction Company has secured a right of way for its proposed electric railway line between Centralia and Rochester, a distance of about ten miles, and will soon commence construction. A.

PEARSON, (CHIHUAHUA), MEXICO.—F. S. Pearson, of New York, and associates who own the Mexico Northwestern Railroad and extensive timber interests in this section, will construct an electric railway to run from Pearson to Colonia Juarez. D.

CORPUS CHRISTI, TEX.—The Corpus Christi Street & Interurban Railway Company is preparing to construct a two-mile extension of its system to the South-Bluff portion of town. This line will be ultimately extended to the Alta Vista hotel. D.

DEVILS LAKE, N. D.—The Stotlar Investment Company will proceed with electrifying the Devils Lake-Chautauqua Railway. An order for 5,000 ties has been placed in Duluth for delivery April 1. Negotiations are under way for electrical equipment. C.

BELLEVUE, MICH.—Plans are being considered for the building of an electric line between Albion, Charlotte and Olivet. The course of the proposed road is over a roadbed which was laid out and graded over fifteen years ago and is now in evidence running through Olivet.

SPEARFISH, S. D.—Spearfish and Belle Fourche men are interested in a project for an electric railway between the two towns. A. A. Modie, of Belle Fourche, Seth Bullock, of Deadwood, and others, are interested. The company will be called the Belle Fourche & Spearfish Electric Railway. C.

TEMPLE, TEX.—It is announced that L. V. Watkins, of Dallas, president of the Trinity Valley Traction Company, states that he will be ready to organize and incorporate a company within a very short time to build an interurban line between Marlin, Temple and San Antonio by way of Austin.

AUSTIN, TEX.—J. V. Watkins, president of the Trinity Valley Traction Company, is investigating the matter of constructing an interurban electric railway from Marlin, Tex., to San Antonio, *via* Temple and Austin. The proposed line as contemplated will be about 175 miles long through a populous territory. D.

ST. JOSEPH, MO.—The St. Joseph Electric Railway Company has been incorporated with a capital stock of $50,000. The company is a subsidiary to the Kansas City, Clay County & St. Joseph Railway Company, which is building an interurban line connecting Kansas City, St. Joseph, Excelsior Springs and intermediate points.

HAMMOND, LA.—The proposed interurban line between Covington and Houltonville is exciting much attention locally. In the event the line is built it will mean that Hammond will eventually be connected therewith, as the line of the Hammond & Eastern could be utilized as a connecting link between the city and Houltonville.

VALPARAISO, IND.—The Board of Commissioners of Porter County has granted the officials of the Chicago, Indianapolis and Meridian Electric Interurban Railway permission to construct a road through the county including the streets in the town of Miller. President Shaffer announced that work will be commenced on the road within twenty days. S.

KNOXVILLE, TENN.—The roadbed for the new divison of the Knoxville Railway & Light Company that will be built to the Island Home property has been determined. The County Court had previously granted a permit to the Knoxville Railway & Light Company to lay its tracks on this road. A force of men are now at work on the new division.

COLLINSVILLE, ILL.—It is announced that work will commence in the spring on the building of an interurban line between East St. Louis and Terre Haute, Ind., with Collinsville and the Troy on the right of way. Civil Engineer Crocker, of East St. Louis, with a gang of men, was in Collinsville for several days engaged in a preliminary survey.

ANACONDA, MONT.—The Anaconda-to-Georgetown railroad has become a reality. Such is the news conveyed in a telegram from President John D. Ryan, of the B. A. & P. railroad, to Manager Harry A. Gallwey, which gave instructions to make preparations for the extension of the B. A. & P. road to Georgetown. This involves the building of about fifteen miles of track.

ROSLYN, WASH.—The Kittitas Railway & Power Company has engaged the Brown Company, Bailey Building, Seattle, to make surveys and prepare plans for its proposed interurban line from Roslyn to the Cle Elum mining district, a distance of about forty miles. In connection the company will build a hydroelectric-power plant near Cle Elum. The project is estimated to cost about $1,500,000. A.

COLUMBUS, O.—The Columbus, Urbana & Western Electric Railway Company has made application to the State Utilities Commission for permission to issue $5,500,000 of bonds and $50,000 additional common stock to finance the extension of the road to Findlay, where connection will be made with the Toledo, Bowling Green & Southern, thus forming connection between this city and Toledo. H.

SOUTH BEND, IND.—Plans for the completion of the first division of the proposed interurban line from South Bend to Logansport, on which construction work was stopped some months ago, have been announced by R. D. Wynn, of Waukegan, Ill., and F. W. Stillwill, of Chicago, who have become interested in the project. A stock issue of $100,000 will be made, and the line as far as Lakeville will be completed.

SPRINGFIELD, ILL.—The Decatur-Pana Southern Railway Company has been incorporated and will construct a line from Decatur through Macon, Moweaqua and Assumption to Pana, through Macon, Shelby and Christian counties. The principal office is in Decatur, and the capital stock is $25,000. The incorporators and first board of directors are: H. S. Ashcraft, J. W. Lockett, Howard G. Hodgkins and John H. Martin, all of Chicago.

DALLAS, TEX.—President J. V. Watkins, of the Trinity Valley Traction Company, has announced that the Dallas-Palestine interurban railway will doubtless be built during the coming year. The line has been surveyed from the city of Dallas by the way of Waxahachie, Corsicana to Palestine, and the route adopted, and not a great deal of detail work remains to be done before construction work is started. Much of the right of way has already been secured.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

LAS CRUCES, N. M.—The Mountain States Telephone Company has secured a franchise in this city.

UNDERWOOD, N. D.—The McLean County Farmers Telephone Association has been granted a local franchise.

NORTH BRANCH, MINN.—The Ideal Telephone Company has been organized by Theodore Thompson and others.

CHISHOLM, MINN.—The Mesaba Telephone Company proposes to make improvements to the police signal system. C.

ROMULUS, OKLA.—The Romulus Rural Telephone Company has been incorporated with a capital stock of $1,500.

ETHER, MONTGOMERY COUNTY, N. C.—The Secretary of State has issued a charter to the Ether Bural Telephone Company; authorized capital, $10,000.

OKLAHOMA CITY, OKLA.—A charter has been issued to the Romulus Rural Telephone Company; capital, $1,500; Incorporators: G. W. Polk, A. N. Brown and W. G. Worrell, all of Romulus

WHITTIER, CAL.—The Home Telephone Company of Whittier has leased new offices and will enlarge and improve its exchange. The company also plans for extensions in its system. A.

FELLOWS, CAL.—The Kern Mutual Telephone Company will build a new telephone exchange at Fellows. New lines will be constructed in this vicinity. T. J. Maguire is manager of the company. A.

CLEBURNE, TEX.—The Cleburne Telephone Company announces that it will make improvements to its exchange and system here at a cost of about $50,000. New equipment will be installed, the lines extended and the wires placed underground in the business district. W. E. Osborn is manager. D.

GAS CITY, IND.—There is to be a modern telephone system between this city and Jonesboro. The Central Union Telephone Company will expend a large sum in installing a new cable system. Work will be started soon under the supervision of Harry Lindsey of Chicago. The new exchange will be at Gas City. S.

AMARILLO, TEX.—Formal transfer of the Panhandle Telephone & Telegraph Company's property in this city has been made by H. B. Sanborn and J. E. Nunn, of this city, to A. L. Waterbury and his associates of Chicago, the consideration being approximately $200,000. The new owners take charge at once.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company has commenced the installation of new submarine cables between San Francisco and Oakland, and a new underground conduit system in San Francisco. The company will also improve its line between Oakland and Sacramento with new cross-arms and wire. The work is estimated to cost $50,000. A.

MORAN, IND.—The Moran Telephone Company has filed articles of incorporation with the declared purpose to construct, maintain and operate telephones and telephone exchanges in the town of Moran and the adjacent territory. H. C. Hurless, N. W. Rodenberger, O. Z. White and E. O. Bond are directors. The capital stock is $3,000. S.

LINDSAY, CAL.—For the purpose of taking over the local telephone company and its patronage a Home Telephone Company has been organized. The new company will expend about $4,000 for improvements. The following officers were named: G. C. Harris of Tulare, president; Lawton Thomas of Fresno, secretary; A. M. Robertson of Visalia, general manager. Mr. Robertson has been employed to locate at Lindsay.

LEWISTON, MONT.—The Mountain States Telephone & Telegraph Company will soon commence the construction of a line from Judith Gap to Broadview, Mont., a distance of about 100 miles. The company has purchased the plant and system of the Mutual Telephone Company, of Lewiston, for a consideration said to be $150,000. The purchasers will make many improvements and additions in the system and plan for the erection of a new local exchange.

ELECTRICAL SECURITIES.

The Portland Railroad Company, controlling 102 miles of street railway in Maine, has sold at A. B. Leach & Company, New York City, $350,000 four and one-half per cent five year coupon notes, due December 1, 1916. Proceeds will be used to retire floating debt and provide funds for additions and extensions.

Miamisburg & Germantown Traction Company bonds, held by the Cincinnati Trust Company, have been extended for ten and one-half years. The agreement was entered into by the Cincinnati, Dayton & Toledo Traction Company, the Ohio Electric Railway Company and the Cincinnati Trust Company. The bonds were payable December 1, 1911, and the extension is granted until July 1, 1922.

DIVIDENDS.

Cincinnati Telephone Company; a quarterly dividend of two per cent, payable January 2.

Consolidated Gas, Electric Light & Power Company, Baltimore; a quarterly dividend of one and one-half per cent, payable January 2.

Duluth Superior Traction Company; regular quarterly dividends of one and one-quarter per cent on the common stock, and one per cent on the preferred stock, both payable January 2 to stock of record December 16.

Interborough Rapid Transit Company; a quarterly dividend of two and one-half per cent, payable January 2 to stock of record December 23.

Manhattan Railway Company; a quarterly dividend of one and three-quarters per cent, payable January 2 to stock of record December 15.

National Gas, Electric Light & Power Company; a regular quarterly dividend of one and one-half per cent on the preferred stock, payable January 1 to stock of record December 26.

New York Edison Company; the regular quarterly dividend of one and one-half per cent, payable December 14.

St. Joseph Railway, Light, Heat & Power Company; the regular quarterly dividend of one and one-quarter per cent on the preferred stock, payable January 2, 1912, to stockholders of record December 15.

Tri-City Railway & Light Company; the regular quarterly dividend of one and one-half per cent on the preferred stock, payable January 2 to stock of record December 22.

Twin City Rapid Transit Company; the regular quarterly dividend of one and three-quarters per cent on the preferred stock and one and one-half per cent on the common stock; both dividends payable January 2, 1912, the former to stockholders of record December 15 and the latter to stockholders who were of record December 12.

West India Electric Company, Limited; a quarterly dividend of one and one-quarter per cent, payaole January 2.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEKS.

NEW YORK.

	Dec. 9.	Dec. 2.
Allis-Chalmers common	2⅛	2½
Allis-Chalmers preferred	8½	11½
Amalgamated Copper	60⅝	62⅛
American Tel. & Cable	*74	*74
American Tel. & Tel.	138¼	139½
Brooklyn Rapid Transit (ex-dividend)	75¼	77½
General Electric	151	152¾
Interborough-Metropolitan common	14⅛	15½
Interborough-Metropolitan preferred	46	48
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common (ex-dividend)	81½	83
Mackay Companies (Postal Telegraph and Cables) preferred (ex-dividend)	71½	72⅛
Manhattan Elevated	134	134
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	46½	47½
U. S. Steel common	61⅝	63¾
U. S. Steel preferred	109	109
Western Union	77⅛	77¼
Westinghouse common	64	64½
Westinghouse preferred	*114	*114

*Last price quoted.

BOSTON.

	Dec. 9.	Dec. 2.
American Tel. & Tel.	138½	139⅝
Edison Electric Illuminating	290	287
General Electric	151	152¾
Massachusetts Electric common	21½	22
Massachusetts Electric preferred	93½	93½
New England Telephone	157½	150¼

PHILADELPHIA.

	Dec. 9.	Dec. 2.
American Railways	45¾	46
Electric Company of America	12	11⅞
Electric Storage Battery common	53½	53¼
Electric Storage Battery preferred	53½	53¼
Philadelphia Electric	15⅝	16⅛
Philadelphia Rapid Transit	23	23
Philadelphia Traction	84¾	84½
Union Traction (ex-dividend)	50¾	52

CHICAGO.

	Dec. 9.	Dec. 2.
Chicago Elevated common	29	28½
Chicago Elevated preferred	91½	91
Chicago Railways, Series 1	95	95
Chicago Railways, Series 2	34	33½
Chicago Subway	⅝	⅝
Chicago Telephone	137½	137½
Commonwealth Edison	133	134
National Carbon common	103	103
National Carbon preferred	118	118

PERSONAL MENTION.

MINOR M. DAVIS has been made chief engineer of telephones of the Postal Telegraph Company.

F. R. COATES, of Chicago, has been elected president of the Toledo Railways & Light Company, succeeding A. E. Lang. Mr. Lang remains a director.

FRANK R. COATES has been chosen president of the Toledo Railways & Light Company, filling the vacancy caused by the resignation of Albion E. Lang.

R. W. PUTZKER, formerly district manager of the Pacific Telephone & Telegraph Company at Santa Cruz, Cal., has been appointed to the same position at Marysville, Cal.

CHARLES W. STONE has been appointed manager of the lighting department of the General Electric Company. The office was recently made vacant by the death of Caryl D. Haskins.

DAVID FENNESSY, formerly manager of the Parral Power & Reduction Company, of Parral, Mex., has become connected with the General Electric Company, El Paso, Tex., district.

P. H. MORTON, Sand Point, Idaho, has been appointed district manager of the Oregon Power Company at Albany, Ore., succeeding D. C. Green, who becomes district manager at Marshfield, Ore.

W. N. MATTHEWS of St. Louis, was married in Minneapolis on November 18 to Mrs. Minnie McDowell. Mr. Matthews is very well known and has a great many friends in St. Louis electrical circles.

FRANCIS W. FROST, formerly secretary and treasurer of the Engineering News Publishing Company of New York City, has been elected to the office of president and treasurer of Suffern & Company, also of New York.

HOMER HEFFNER, formerly employed by the Central Union Telephone Company and the Crawfordsville Light & Power Company, is now located in Lebanon, Oregon, where he is the manager of the Central Union Company.

PAUL B. SAWYER, formerly of Des Moines, Iowa, has taken charge of the property of the Union Electric Company at Dubuque. Mr. Sawyer succeeds L. D. Mathes, who has for many years been general manager of the company.

P. M. LINCOLN, of the Westinghouse Electric & Manufacturing Company, gave a talk at Washington, D. C., on December 12, on the "Water and Electric Power Development at Niagara Falls." The lecture was illustrated by lantern slides.

RUSSELL ARMSTRONG was recently elected first vice-president and member of the executive committee of the Federal Utilities, Inc. Mr. Armstrong was for many years with Harvey Fisk & Sons, and more recently a vice-president of the Electric Bond & Share Company.

ALFRED C. EINSTEIN, president of the St. Louis Gas Company and the Suburban Electric Light & Power Company, has been elected president and general manager of the Union Electric Light & Power Company. Mr. Einstein will succeed Alten S. Miller, who resigned last spring.

J. ALLEN WORTH has recently resigned from the Weber Electric Company to become sales manager of the push-button, switch and specialty department of the Cutler-Hammer Manufacturing Company of Milwaukee. Mr. Worth has been engaged in this field of electrical industry for the past seven years. He, with Henry D. Sears, sales agent for the Weber Company, successfully marketed the first snap shell socket, at a time when the trade was skeptical of their utility. Mr. Worth's experience with the Weber Company since this time fits him for the sales management of the rapidly growing Cutler-Hammer line of switches and specialties.

K. H. HANSEN was recently appointed chief electrical engineer and superintendent of distribution of the Union Electric Light & Power Company, of St. Louis, succeeding S. B. Way, who resigned to take charge of the electrical department of The Milwaukee Electric Railway & Light Company. Mr. Hansen graduated from the University of Missouri at Columbia City, Mo., in 1898. Following graduation he was connected with the former Missouri-Edison Company, the Laclede Power Company, and finally the Union Electric Light & Power Company, where he has been assistant electrical engineer in active charge of much of the work of the electric department for several years.

GLENN MARSTON, of Chicago, sailed Saturday, December 9, on the *Olympic* for a short European trip, during which he will conduct an investigation into the terms of a number of power contracts which have resulted in the abandonment of municipal lighting plants in British and Continental cities. Mr. Marston's trip will cover Great Britain, Germany, Belgium and France. He will also act as representative for the 1912 Boston Electric Show, which will be held from September 28 to October 26 of next year. It is expected that a number of the exhibitors at the recent London Electrical Exhibition will take space in the forthcoming Boston Show, which, it is promised, will be the largest electric show ever held.

OBITUARY.

GEORGE B. MOFFATT, of New York, founder of the Oregon Electric Railway and interested in many other enterprises in the Pacific Northwest, died December 4 at a hopistal in Portland of stomach trouble.

WILLIAM GOODYEAR, manager of the Bell Telephone Company at Chambersburg, Pa., died recently at the Chambersburg Hospital after an operaiton for appendicitis. He is survived by his widow and one sister.

E. A. HAWKINS, who, as a private in the signal service of the Union army, was the first to telegraph to Washington the news of the completion of Sherman's march to the sea, died December 5 in Upper Sandusky, O. Mr. Hawkins was a colonel in the army and was sixty-eight years old at the time of his death.

NEW INCORPORATIONS.

LOS ANGELES, CAL.—The Illinois Electric Company has been incorporated with a capital of $50,000 by Frand E. Healy, Carl Keith, C. B. Hall and A. E. Edwards. A.

LOS ANGELES, CAL.—The Empire Electric Company has been incorporated with a capital stock of $100,000 by E. J. Rose, S. J. Mathias, A. H. Honey and E. J. Ryan.

LOS ANGELES, CAL.—The Miller Storage Battery Company has been incorporated by G. J. Miller, F. J. Miller, C. H. Miller, A. B. Hanson and T. L. Gifford, with a capital of $10,000. A.

INDIANAPOLIS, IND.—The American Electric Company has incorporated to manufacture electric motors and generators. The capital stock is $10,000 and the directors are R. A. Love, Robert Steven and P. G. Winter.

INDIANAPOLIS, IND.—The Empire Gear & Manufacturing Company has incorporated to manufacture electrical goods. The capital stock is $20,000, and the directors are F. S. Clark, C. H. Hurd, H. M. Talbot, A. H. Off, L. F. Hellmann, Wesley Haufler and F. J. Moore.

INDIANAPOLIS, IND.—The American Electric Company has been incorporated to manufacture, sell and repair electric motors and generators, gas and steam engines, electric and other machinery. The capital stock is $15,000. Roscoe A. Lowe, Robert Stevens and Paul G. Winter are directors. S.

NEW CASTLE, IND.—The Whitesides Commercial Car Company has incorporated, capitalized at $61,250. The object of this corporation is to manufacture and sell commercial trucks and other motor vehicles, automobile parts, gas engines and electric devices with the right to hold real estate, establish and equip a plant, install power machinery, etc. The directors are Orlando C. Saffell, Francis N. Whitesides, Lynn C. Boyd, William G. Hillock and Thomas B. Milligan. S.

NEW PUBLICATIONS.

INDUSTRIAL EDUCATION.—The Commissioner of Labor has issued his twenty-fifth annual report for the year 1910, dealing with the subject of Industrial Education. It considers not only idustrial schools but apprenticeship schools in connection with large railways, electrical companies and others.

BULLETIN OF THE BUREAU OF STANDARDS.—No. 3, Vol. VII. of the *Bulletin* has been issued under date of October, 1911. It contains articles by L. W. Austin on "Some Quantitative Experiments in Long-Distance Radiotelegraphy;" by T. T. Fitch and C. J. Huber on "Comparison of American Direct-Current, Switchboard Voltmeters and Ammeters;" by P. G. Agnew on "A Study of the Current Transformer with Particular Reference to Iron Loss;" by Henry S. Carhart on "Thermodynamics of Concentration Cells."

TESTS OF A SUCTION GAS PRODUCER, by C. M. Garland and A. P. Kratz, is issued as Bulletin No. 50 of the Engineering Experiment Station of the University of Illinois. This bulletin gives the results of twenty-five tests made on a small suction gas producer, for the purpose of obtaining data on the efficiency, reliability, and operation of suction producers of small size, using anthracite as a fuel. The theory of gas producers is discussed at some length. The conclusion is reached that a producer of the above type is a practical piece of apparatus for a class of work not requiring close regulation; also that the percentage of CO_2 in the gas can vary within wide limits without affecting the efficiency of operation. A very complete set of forms for reporting tests has been drawn up, and the formulas for calculating the trials have been deduced. Copies of Bulletin No. 50 may be obtained gratis upon application to W. F. M. Goss, direcor of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

PROPOSALS.

WIRING—The office of the Supervising Architect, Washington, D. C., will receive sealed bids for wiring, and installing conduits and interior lighting fixtures in the following postoffice buildings. Bids close on the dates given below:

Date.	Postoffice.
January 8	Ellsworth, Me.
January 4	Laporte, Ind.
January 9	Mattoon, Ill.
January 10	Gaffney, S. C.
January 12	Mansfield, O.
January 13	Bismarck, N. D.

Drawings and specifications may be obtained from the custodian of site at the various places where work is to be carried out, or from the Supervising Architect's office.

INDUSTRIAL ITEMS.

THE NEW YORK INSULATED WIRE COMPANY, New York, N. Y., advertises its Grimshaw tape and Raven white-core wire on recent blotters.

SMITH & HEMENWAY COMPANY, 150 Chamber Street, New York, N. Y., announces that suit for patent infringement which was brought against them on account of the three-point tool has been dismissed by the United States Circuit Court of Appeals, which decided that this tool did not infringe the patent.

THE NATIONAL METAL MOLDING COMPANY, Pittsburgh, Pa., has printed in a folder pictures of a number of Western buildings in which "Sherarduct" is used exclusively. Sherarduct is a rigid conduit, zinc-treated on both the inside and outside; it bends easily and has sharp clean-cut threads.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is mailing to supply companies blotters calling attention to the high efficiency of the Edison Gem Lamp. These will be sent in quantities to the selling company, stamped with their name. They are of a size suitable for mailing with monthly bills, etc.

ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT, Berlin, Germany, has mailed a number of bulletins describing material which has just been placed on the market. In Bulletin No. 3 is included a description of the automobile tower wagon for repair work on trolley lines, while Bulletin No. 4, is devoted to the company's new line material. Bulletin No. 5 illustrates and describes a new type of railway motor. In a separate folder is a description of a voltage indicator which may be left permanently hanging from a line, and will tell whether the line is alive or not.

THE SHELBY ELECTRIC COMPANY, Shelby, O., recently made a number of installations of high-wattage Mazda lamps in Cleveland, O., business houses. Among these are F. & R. Lozams Company's department store, Columbia Dry Goods Company, Capitol Clothing Company, and The Fashion Store. At Mt. Vernon, O., an installation of 400-watt and 250-watt units was made in the Ringwalt Department Store. These installations are a result of the energy of A. E. Loeb, of the Avery-Loeb Electric Company of Columbus, and John D. Conrad of the sales force of the Shelby Electric Company.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburgh, Pa., has issued circular 1198, describing alternating-current water-wheel generators. The publication illustrates and describes the different types of generators, both vertical and horizontal, for water-wheel drive, manufactured by that company. The Westinghouse Company has several different types of rotor construction each of which is adapted for a certain rotor diameter and speed range. These types of construction are described in considerable detail. Other components of the water-wheel generators are given attention and many pictures of installations are shown. Numerous illustrations of water-wheel driven installations are shown.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, O., has issued a booklet entitled "From Post Hole to Lights On" to supply full information, particularly cost data, pertaining to Mazda street-lighting systems. Detailed cost lists of poles, wire, regulators, transformers, cutouts, switchboards, ornamental standards, lamps, globes, etc., as well as the installation expenses involved in equipping such systems are furnished so that the book will serve as a complete and convenient hand-book for engineers, municipalities, business-men's clubs and boards of trade or others interested in improved modern street lighting. A booklet entitled "Warren Beautiful," sent out by the same company, contains an address delivered by William Coale, treasurer of that concern. Warren, as is well known, was the first city in the United States to adopt Mazda street lighting to the exclusion of all other methods and the paper prepared by Mr. Coale takes up the installation in detail.

DATES AHEAD.

American Institute of Chemical Engineers. Annual meeting, Washington, D. C., December 20-22.

American Association for the Advancement of Science. Annual meeting, Washington, D. C., December 27-30.

American Institute of Consulting Engineers. Annual meeting, New York City, January 16, 1912.

Western Electrical Inspectors' Association. Milwaukee, Wis., January 23-25, 1912.

National Independent Telephone Association. Annual convention, Chicago, Ill., February 7, 8 and 9, 1912.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 17-20, 1912.

The 1912 Boston Electric Show. Mechanics Building, Boston, Mass., September 28-October 26, 1912.

RECORD OF ELECTRICAL PATENTS.

Issued by the United States Patent Office, December 5, 1911.

1,010,409 and 1,010,410. APPARATUS FOR USE IN THE DISTRIBUTION OF ELECTRIC CURRENTS. A. F. Berry, assignor to General Electric Co. A set of main and supplementary transformers is connected across the line, the latter transformers having their coils in series with the corresponding coils of the main transformers and so arranged that they are short-circuited at a certain load.

1,010,412. SPEED-LIMIT SIGNALING APPARATUS. F. M. Butler, David City, Nebr. An automobile speedometer has a series of electric contacts connected to a corresponding series with a lamp signal and bell.

1,010,413. TRANSMITTING APPARATUS FOR TELEGRAPH SYSTEMS. A. C. Crehore, Yonkers, N. Y. A multiple telegraph transmitter has a circuit-closer connected to each generator terminal.

1,010,414. THERMOSTAT. A. S. Cubitt, assignor to General Electric Co. Comprises a thermostatic switch element and a thermostatic locking element for engaging the same.

1,010,415. COMBINED WATCHMAN'S CLOCK AND TELEPHONE SYSTEM. F. G. Duryee, assignor to General Electric Co. Combined with an electric recorder controlled from each watchman's station are means for connecting a portable telephone at the station.

1,010,416. ELECTRICITY METER. E. Evans, assignor to General Electric Co. A magnet is arranged to swing near the damping disk when the energy consumption exceeds a certain rate and thus escapes a higher-speed registering train to record.

1,010,420. SYSTEM OF DISTRIBUTION. J. J. Frank, assignor to General Electric Co. Auto transformers between the main buses connect with auxiliary buses and the latter connect with a supplemental bus through plug sockets.

1,010,422. CIRCUIT-BREAKER. W. P. Hamlyn, assignor to General Electric Co. Relates to the toggle mechanism of an overload breaker with laminated bridging contacts.

1,010,425. ELECTRIC SWITCH. E. M. Hewlett, assignor to General Electric Co. An air-brake high-tension switch has a reciprocating contact associated with a horn gap.

1,010,428. CAR FENDER. N. J. Holden, Montreal, Quebec. Tripping of the fender causes simultaneous operation of the air brakes and sander and reversal of the electric motors.

1,010,444. PROCESS OF TREATING COILS. J. I. Mitchell, assignor to General Electric Co. Transformer coils are impregnated with japan and hardened at a low temperature to hold them in place, then further impregnated with an insulating compound and hardened at a higher temperature.

1,010,448. MAKE-AND-BREAK SPARKING DEVICE. C. H. Newton, assignor to Progressive Manufacturing Co., Torrington, Conn. Has a sliding contact for each engine cylinder.

1,010,449. SANITARY TELEPHONE TRANSMITTER. J. H. O'Connell, Boston, Mass. Instead of a mouthpiece there is a smooth front plate thinner at the middle than at the edges and adapted to readily transmit its vibrations to the diaphragm.

1,010,455. MERCURY-VAPOR LAMP. A. E. Richardson, assignor to General Electric Co. Has a high-resistance filament movable with respect to the anode, automatic means for moving the filament, and a metallic spiral connecting the filament and anode to insure a low resistance path between them.

1,010,456. METHOD OF EVACUATING VACUUM APPARATUS. O. Schaller, assignor to General Electric Co. The method of improving metal-filament lamps evacuated by means of an exhaustion system in which a liquid is employed consists in keeping such liquid at a low temperature.

1,010,465. CLUSTER-SOCKET. J. C. Tournier, assignor to General Electric Co. Metal rods connect the center contacts of the sockets to one binding post. The socket shells are connected to each other and to the other binding post.

1,010,466. SYSTEM OF ELECTRICAL DISTRIBUTION. W. E. Ver Planck, assignor to General Electric Co. In series with a storage battery is a booster that is started and stopped and whose voltage is regulated by a potential and current regulator.

1,010,471. TELEPHONE SYSTEM. C. S. Winston, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Relates to the connection of two relays associated with the cord circuit and controlling a supervisory lamp.

1,010,478. SUBSCRIBER'S TELEPHONE APPARATUS. H. P. Clausen, assignor to Stromberg-Carlson Telephone Manufacturing Co., Rochester, N. Y. A condenser is included in both the bell and talking circuits.

1,010,497. ELECTRICAL SYSTEM OF DISTRIBUTION. A. S. Hubbard and E. Van Wagenen, assignors to Gould Storage Battery Co. A storage battery for regulating both a direct-current and alternating-current system has associated with it a rotary converter, a booster and several regulating devices and machines.

1,010,500. TRANSFORMER. S. E. Johannesen, assignor to General Electric Co. A bell-ringing transformer has a core of insulated wire connected in series with the primary to act as a resistance.

1,010,504. THIRD-RAIL COVERING. F. H. Lindsley, Pawtucket, R. I. The rail is protected by a box with pairs of long hinged doors over its upper portion; the contact shoe has inclined wheels that open the doors.

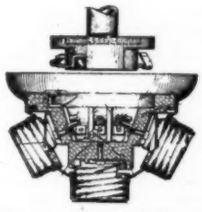
1,010,505. TELEPHONE SYSTEM. R. H. Manson, assignor to Dean Electric Co., Elyria, O. Relates to the connections of a registering meter for providing measured service.

1,010,522. DYNAMO-ELECTRIC MACHINE. H. Roos, assignor to General Electric Co. The rotating field structure has ventilating slots about its coils.

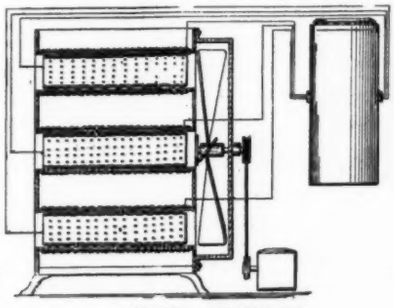
1,010,527. SWINGING HOT-SAW FOR ROLLING-MILLS. A. W. Starck, Skofde, Sweden. A pendulum frame has an electric motor mounted on its lower end; the circular saw is directly on the motor shaft.

1,010,529. ELECTRICALLY HEATED TOOL. G. E. Stevens, assignor to General Electric Co. A soldering iron with an electric heating coil in its head and a coiled spring handle through which the cord passes.

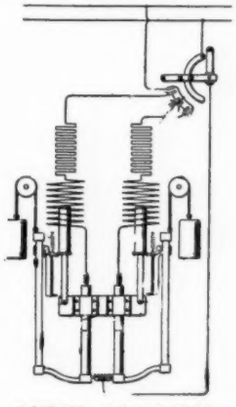
1,010,531. TELEPHONE INSTRUMENT. W. F. Taylor and V. Durbin, assignors to Holtzer-Cabot Electric Co. A desk stand has a telescoping upright to permit the transmitter head and hook-switch to be removed bodily.



1,010,465.—CLUSTER SOCKET.



1,010,777.—OZONIZER.



1,010,900.—ARC LAMP.

1,010,533. DYNAMO-ELECTRIC MACHINE. E. M. Tormin, assignor to Holtzer-Cabot Electric Co. Has four windings on the armature to give one, two, three and four cycles per revolution, respectively.

1,010,552. SHEET-ADJUSTING DEVICE FOR MECHANICAL MUSICAL INSTRUMENTS. J. A. Weser, New York, N. Y. The device is electromagnetically controlled according to the movement of a detector.

1,010,590. TELEPHONE-TRANSMITTER. H. P. Clausen, assignor to Stromberg-Carlson Telephone Manufacturing Co., Rochester, N. Y. Has a supplemental diaphragm secured by clamping rings to the back of the main diaphragm. Granular carbon is interposed between carbon blocks secured to the inside of each diaphragm.

1,010,591. APPARATUS FOR GENERATING ELECTRIC CURRENTS. W. B. Clements, Veedum, Wis. A windmill pumps water to an elevated storage tank from which it flows through a water turbine that drives the generator.

1,010,592. INSULATING BUSHING FOR ELECTRIC CONDUCTORS AND BINDING-POSTS. F. W. Cole, assignor to Gamewell Fire Alarm Telegraph Co., New York, N. Y. Has a conical enlargement at each end, one smaller than the other to permit passing through a hole; there is a collar around the smaller end.

1,010,593. WIRELESS - TELEPHONY APPARATUS. V. Colin, Neuilly-sur-Seine, and M. Jeance, Paris, France. Includes an electric arc with a water-cooled metallic anode and a thin carbon-pencil cathode in a conducting holder with large radiating surface.

1,010,606. COMBINATION LIGHTNING ARRESTER AND FUSE BLOCK. E. B. Fahnestock, New York, N. Y. Consists of two tubular fuses mounted on the same block as and connected to the lightning arrester.

1,010,620. ELECTRIC SWITCH. W. J. Crumpton, Superior, Wis. Consists of a sealed chamber having an upper and a lower liquid terminal container joined by a restricted passage.

1,010,638 and 1,010,639. ELECTROPLATING RACK. J. F. Kitchen, assignor to Spirella Co., Meadville, Pa. A cathode rack comprises a number of contact members for supporting the work while entirely submerged, and means for shifting the work on the contact members.

1,010,640. SWITCH DEVICE. O. K. Kjolseth, assignor to General Electric Co. The movable arm of a rotary switch swings between two fixed contacts that have a fuse between them.

1,010,641. RESISTANCE UNIT. C. D. Knight, P. H. Zimmer and J. B. Ford, assignors to General Electric Co. Comprises an asbestos tube provided with porcelain ends, and a resistance conductor wound thereon and embedded in a mineral silicate.

1,010,647 and 1,010,648. ELECTROPLATING-RACK. C. E. Leffel, assignor to Spirella Co., Meadville, Pa. These patents like 1,010,638, relate to various forms of cathode hanger with work-supporting projections.

1,010,651. TROLLEY-POLE ARRESTER. R. S. Lillico, Seattle, Wash. Sudden jerking of the trolley rope causes a set of dogs to release a weight in a casing on the rear dash of the car and its fall pulls the rope and trolley pole down.

1,010,663. ELECTRIC-CIRCUIT CONTROLLER. A. Meadows, Detroit, Mich. A rotary snap switch in a circular casing has a permutation lock for keeping the switch from being tampered with.

1,010,666. COMMUTATOR SWITCH. R. Miller, Ann Arbor, Mich. A series of contact buttons is secured to a rotatable disk so as to be engaged by contact fingers on a circular plate.

1,010,668. VACUUM-TUBE LAMP. D. McF. Moore, assignor to Electrical Co., New York, N. Y. Has a compound internal electrode consisting of a cylindrical charge-receiving conductor connected to one leading-in wire and an incandescent filament sealed within the base of the tube.

1,010,669. WIRELESS - TELEGRAPH APPARATUS. D. McF. Moore, assignor to Moore Electrical Co., New York, N. Y. A wave detector consists of a vacuum tube the gas tension and resistance of which is kept constant by a regulating circuit.

1,010,670. AUTOMATIC GAS-FEED FOR VACUUM TUBES. D. McF. Moore, assignor to Moore Electrical Co. Porous material is interposed in the gas feed. Decreased resistance of the tube causes current to pass through an electric heater that warms the porous material so as to admit more gas to restore normal conditions.

1,010,693. BATTERY-ELEMENT SUPPORT. C. B. Schoenmehl, Waterbury, Conn. A compressed circular negative plate is held between in a channel frame secured to the battery cover.

1,010,695. BATTERY VENT-PLUG. J. R. Sloan, Altoona, Pa. A vent for a storage battery has two circular rims in the plug with the channel between them drained into the cell; an interlocking cap screws over the outer rim.

1,010,722. INSULATED ADJUSTABLE TROLLEY-CROSSING. H. W. Clapp, and B. C. Edgar, San Francisco, Cal. Each of the intersecting lines has an adjustable turntable with wood insulating blocks.

1,010,753. ELECTRIC SWITCH. E. A. Halbleib, assignor to Northeast Electric Co., Rochester, N. Y. Has a longitudinally movable key-operated locking bar with switch plugs arranged on it transversely and movable longitudinally into two positions.

1,010,757. PULSAMETER. H. E. Heath, Hartford, Conn. A frequency meter with a series of spring arms of varying lengths and means for connection to the circuit.

1,010,777. OZONIZER. R. M. Leggett, Ann Arbor, Mich. Has a tubular dielectric within which is a sheet terminal bent into split tubular form and provided with numerous perforations.

1,010,802. ROUTE-INDICATOR. B. O. Rhodes, assignor to J. B. Rhodes, Kalamazoo, Mich. An odometer with distance and guide indexes has an electric alarm associated with the latter.

1,010,814. COMBINATION LOCK FOR ELECTRIC LAMPS AND THE LIKE.—G. I. Silbert, assignor, to Chi-Ill Electric Co., Chicago, Ill. A combination lock fastens the lamp to a support, the locking elements forming part of the circuit.

1,010,850. INSULATED RAIL JOINT. J. H. Brothers, assignor to Rail Joint Co., New York, N. Y. Insulation is interposed between corrugated splice bars fitting in the filler members.

1,010,863. ELECTRICALLLY OPERATED ELEVATOR-GATE MECHANISM. G. Colby, New Paris, O. The gate of a freight elevator is raised by a motor as the car approaches the floor, automatically closing as the car leaves.

1,010,864. SWITCH INSTRUMENT. C. W. Coleman, Westfield, N. J., assignor to Hall Signal Co. A contact controlling member on a shaft is so fixed as to permit of angular adjustment.

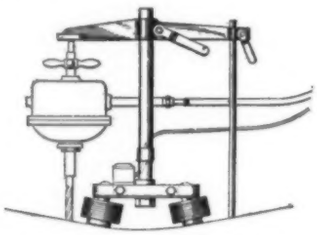
1,010,866. PROCESS OF MAKING COMPOSITE CONDUCTORS. W. D. Coolidge, assignor to General Electric Co. A thread of thoria is coated with copper on which is deposited a layer of tungsten; the copper is then removed, leaving the thoria filament incased in tungsten.

1,010,889. TROLLEY. G. Frivalszky, Chicago, Ill. A wide trolley wheel with a V-shaped groove has spiral beads which push the trolley to the bottom of the groove.

1,010,891. SOLDERING IMPLEMENT. C. W. Gamble, Montreal, Can. Contact posts, to which the heating coil is connected, fit into contact members in the supply circuit.

1,010,897. ELECTRIC GAS-LIGHTER. H. D. Grinnell, Pittsfield, Mass. The flame is lighted by a spark.

1,010,900. ARC LAMP. C. A. B. Halvorson, Jr., assignor to General Electric Co. The lower electrodes are moved upward by weights, co-operating with the upper electrodes, which are actuated by electromagnets.



1,010,975—TOOL HOLDER.

1,010,907. METHOD OF PREVENTING ALTERNATING-CURRENT ELECTROLYSIS. J. L. R. Hayden, assignor to General Electric Co. Consists in superimposing upon the alternating current a uni-directional current between earth and metal.

1,010,914. MACHINE FOR TREATING FILAMENTS. J. W. Howell, assignor to General Electric Co. Automatic means charge the treating receptacle with the desired quantity of treating fluid.

1,010,920. HIGH-TENSION INSULATOR. B. D. Kenney, assignor to R. Thomas & Sons Co., East Liverpool, O. The hinging bolts connecting the units lock when the insulator is in position under strain.

1,010,922. TROLLEY. C. Kordek and J. Kordek, Philadelphia, Pa. A spring attachment is fixed to a trolley harp.

1,010,936. ELECTRIC CONDENSER. M. Meirowsky, Cologne-Ehrenfeld, Germany. A film of fibrous material saturated with resinous substance is rolled on a spindle while hot, tinfoil being interposed between layers of the roll during winding.

1,010,937. OIL SWITCH. J. F. Menningen, assignor to Allis-Chalmers Co., and Bullock Electric Manufacturing Co. Two movable contact arms each swing in a ball-and-socket joint, the free ends of the arms being provided with interfitting ball-and-socket engaging surfaces.

1,010,942. ARC-LIGHT ELECTRODE. B. Monasch, assignor to General Electric Co. The cathode is formed of a metal tube with a filling in which rutile predominates, the anode being formed of a tube in which an iron filler is contained.

1,010,961. SYSTEM OF DISTRIBUTION. G. B. Schley, assignor to Allis-Chalmers Co. A multiple-voltage system of distribution in which asymmetric conductors cut out the field of one balancing generator where the ratio of loads departs from normal.

1,010,975. TOOL HOLDER. George Stroner and William C. Buege, Globe, Ariz. The plate to be drilled is held in position against a portable tool by a pair of electromagnets.

1,010,982. NEUTRALIZING INDUCTIVE DISTURBANCES. J. B. Taylor, assignor to General Electric Co. At intervals along the system are placed transformers having their primary windings in series with one conductor and their secondary windings in series with the other conductor.

1,010,985. ELECTRIC-LAMP SOCKET. G. B. Thomas, assignor to Bryant Electric Co., Bridgeport, Conn. Has an independent screw-nipple member mounted on the body of the socket.

1,010,987. MAKE-AND-BREAK SPARKER FOR INTERNAL-COMBUSTION ENGINES. E. Thomson, assignor to General Electric Co. The break is made by a cam turning in synchronism with the engine shaft, causing each cylinder to be exploded in turn.

1,010,990. REGULATING DEVICE. E. A. Wagner, assignor to General Electric Co. A single switch connects the compensator in circuit and also short-circuits the reactive coil.

1,010,998. DYNAMO-ELECTRIC MACHINE. R. B. Williamson, assignor to Allis-Chalmers Co., Milwaukee, Wis. A number of concentric retaining rings are used to hold the section of the windings in place in their slots.

1,011,018. METHOD OF INCREASING THE POWER-FACTOR AND THE STABILITY OF ELECTRIC FURNACES. K. Birkeland, assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab Christiania, Norway. The current is divided into a number of parts, out of phase, by multiply-connected inductance.

1,011,020. NEUTRALIZING INDUCTION FROM ALTERNATING-CURRENT RAILWAYS. W. S. Bralley, assignor to General Electric Co. A neutralizing conductor placed near the conductor to be protected is connected in shunt with the rails.

1,011,045. SOUND-INTENSIFIER FOR TELEPHONE MOUTHPIECES AND THE LIKE. H. Foss, Dombaas, Norway. A spherically shaped sound box is connected to the transmitter by a tube bent at right angles.

1,011,070. ELECTRIC CIRCUIT-CLOSER AND BREAKER. T. H. McQuown, assignor to A. A. Kent, Philadelphia, Pa. The contacts are pushed together by a cam rotated by an oscillating lever.

1,011,088. ELECTRIC LIGHTING. C. P. Steinmetz, assignor to General Electric Co. Two electrodes of a mercury-vapor lamp are impressed with line voltage, another electrode having a voltage intermediate in value.

1,011,097. CIRCUIT-BREAKER. H. L. Van Valkenburg, assignor to Bullock Electric Manufacturing Co. A pivoted switch is held in place by bell-crank latch.

1,011,118. INSULATING DEVICE FOR ELECTRIC CABLES. P. Carolan, Cleveland, O. Fusible cuffs project from the end of the insulating sleeve.

1.011,129. MOTOR SUPPORT. E. D. Mackintosh, assignor of one-half to S. S. Hepworth Co., New York, N. Y. A normally vertical motor is supported by rockers.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired December 11, 1911:

530,498. INSULATOR FOR ELECTRIC OVERHEAD CONSTRUCTIONS. Henry P. Ball, Bridgeport, Conn.

530,507. CONTROLLER FOR ELECTRIC LOCOMOTIVES. John W. Darley, Jr., Baltimore, Md.

530,516. SUPPRESSION OF SELF-INDUCTIVE OBSTRUCTION IN ELECTROMAGNETIC APPARATUS. Stephen D. Field, Stockbridge, Mass.

530,517. PROCESS OF MANUFACTURING INSULATING COMPOSITIONS FOR ELECTRICAL PURPOSES. Alfred N. Ford, London, England.

530,541. APPARATUS FOR CONTROLLING ELECTRIC ELEVATORS. Nils O. Lindstrom, Union Course, and Orrie P. Cummings, Brooklyn, N. Y.

530,543. CONDUIT ELECTRIC RAILWAY. David Mason, Schenectady, N. Y.

530,575. TELEPHONE TRANSMITTER. Arthur F. Boardman, Somerville, Mass.

530,578. ELECTRIC ELEVATOR CONTROLLER. Leroy S. Buffington, Minneapolis, Minn., and Walter C. Jones, Chicago, Ill.

530,597. ALTERNATING-CURRENT TRANSFORMER. Alexander W. Meston, St. Louis, Mo.

530,598. TELEPHONE SYSTEM. Wilhelm Oesterreich, Berlin, Germany.

530,619. ELECTRIC-MOTOR-PROPELLED ELEVATOR. Frank E. Herdman, Indianapolis, Ind.

530,637. ELECTRIC CIGAR LIGHTER. Clyde J. Coleman, Chicago, Ill.

530,648. FIRE-ALARM AND ANNUNCIATOR SYSTEM. Frederick S. Palmer, Boston, Mass.

530,717. BRUSH FOR DYNAMO-ELECTRIC MACHINES. Edward T. Platt, Chicago, Ill.

530,762. ELECTRICAL BLOCK-SIGNAL APPARATUS. Urias J. Fry, Milwaukee, Wis.

530,763. BLOCK-SIGNAL APPARATUS. Urias J. Fry, Milwaukee, Wis.

530,764. PRIMARY BATTERY. George H. Gardner, Boston, Mass.

530,773. ELECTRIC MOTOR. Frank E. Herdman, Winnetka, Ill.

530,882. ARC-LIGHT HANGER BOARD. David J. Cartwright, Boston, Mass.

530,895. INCANDESCENT ELECTRIC LAMP. Edward Kaye, Monaca, Pa.